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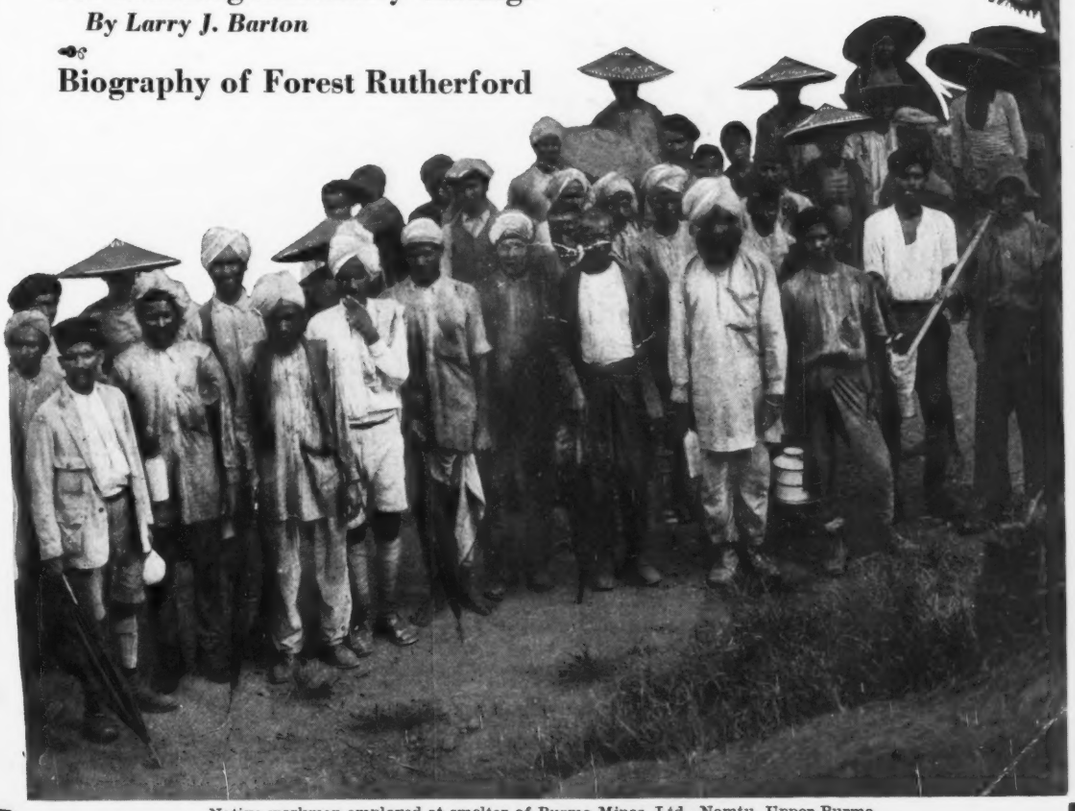

Native workmen employed at smelter of Burma Mines, Ltd., Namtu, Upper Burma

A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

April 7, 1923

Many mines now employ S-A Unit Carriers exclusively

In recent years S-A Unit Carriers have come into such general use for the belt-conveyance of ores that they have, by their sterling performance under all conceivable conditions, established for themselves, in the minds of mining men, a preference which has its tangible manifestation in the fact that many mines now employ S-A Unit Carriers exclusively. This is most convincing evidence of merit and should not be overlooked by mining men in contemplating new conveyor installations or the extension of old ones.

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 115 | New York, April 7, 1923 | *Number* 14

The Expanding Uses for Copper Salts

A CALL for tenders for the supply of a large quantity of copper sulphate, by the Water Supply Department of the City of New York, draws attention to the growing utilization of copper compounds. Considerable trouble has been experienced in a number of domestic water supplies, because of the growth of an alga or algæ, which causes rapid deterioration. Aëration, by spraying, has been used to check this, but more drastic steps were found necessary. A minute amount of copper sulphate, about 2 lb. per 1,000,000 gal., is added before filtration, the total requirements of the water-supply projects delivering to the big cities being considerable. The copper sulphate is said to remove the characteristic and unpleasant taste that arises from the presence of algæ, and destroys bacteria.

Another use for copper sulphate is seen in a comparatively new type of road material, composed of the usual asphalt concrete, to which has been added copper sulphate, in amount equal to about 3 per cent of the weight of the asphalt. The salt appears to have some tempering effect on the asphalt, which inhibits "running" when exposed to high-temperature atmospheric conditions. A stretch of road between Los Angeles and San Pedro harbor offers convincing evidence of the value of the copper sulphate as an additive to asphalt concrete.

Still another unusual use for copper, on a comparatively large scale, is forecast in a report that the oleate has been found to be effective for the "curing" of fishing nets, and for impregnating them so that the unwelcome attentions of marine pests, whose appetite for the twine is unaffected by the coating of tar usually employed, are discouraged. The copper oleate has also been found useful in preventing the occurrence of mold.

The foregoing facts prompt comment that all the uses of metals have not been discovered. Research on the part of metallurgists and chemists should result in the extended utilization of metals in compound form, for the prevention of waste, decay, and pollution, and in many other useful applications.

The Mine Financing Problem

MANY OF OUR READERS write to us commending our hostility to wildcat and unscrupulous mine promotions and mine stock offerings. They wholly approve of our policy and of the principle; but they point out that there is still lacking a policy of constructive suggestions as to how the inexperienced prospector or mine owner or small group of mine owners shall finance a small property without violating the ethics of mine promotion and finance, which they are anxious to observe, but concerning which they lack any chart whatever which would show them where are the dangerous reefs behind which sharks lie in wait, and where are the snug harbors.

In truth, it is easier to point out the defects in any course of action than to lay out a course of action which shall be free from defects. Accurate destructive criticism is easier than accurate constructive planning. When a constructive plan, moreover, is broached and pushed by editorial initiative and policy, our readers at once assume the rôle of critics and bombard us quite vigorously, pointing out where they think we are hopelessly wrong and befuddled. The result is that all of us—editors and readers—are prone to adopt the safe and superior rôle of critics, and so join the overwhelming majority.

The proponent of a constructive plan, if it be new, is accused of fathering a fad, or even of being a "reformer," than which last term there is none more damaging to a man's or a paper's reputation. The resultant of net forces therefore continually tends to repress the constructive attitude of journalism and to encourage the critical; with the result of the development of well-known cases of chronic pessimism and irritability in editors and statesmen. Note Johnson, Borah, and Reed, for example, in the United States Senate. The resultant of the forces of public opinion which bear upon them is that they have fallen into the habit of fulminating against everything that anybody else—the President, Big Business, or what not—may conceive of and seek to establish. As to journalism, we do not need to illustrate our thesis by specific cases.

Yet the plea of our readers is a fair one: that if we are so prolific in telling them what not to do in developing a mine from the financial point of view, we should also consent to take the exposed position (strategically) of telling them how it should be done. Unfortunately, this is not so easy, or, at any rate, not so categorical. The case where a mine "pays for itself from the grass roots" still exists, but such cases are continually rarer. The average promising mine cannot start financially on a shoestring, and pay its way as it goes: it needs the aid of modern machinery and milling methods before it can show a profit.

A preliminary suggestion, if a vague one, would perhaps be that of the practice of slowly widening circles of endeavor and of finance; and that the likelihood of error and malpractice increases as the enthusiastic promoter skips larger and larger intervals in his methods. As an extreme example of the latter, a man forms a corporation, gets an oil lease, or an option on a copper mine, and bombards small fry from Maine to California with flamboyant literature to raise money to develop the oil lease or the copper mine. This is unethical and is fundamentally unfair and crooked, and the always ignorant investor has not a one per cent chance of getting his money back. This is the opposite extreme from making the mine pay for itself from the grass roots—if it will. From this last-named safe (if pos-

sible) center the miner and promoter should reach out gradually on his way from his cabin door to Wall Street, shunning extreme methods and searching for help near at hand. A case which we commended some time ago was the financing of a mining project in Leadville by the merchants and miners and engineers of Leadville, under the auspices of the Leadville Chamber of Commerce. We do not know the outcome of this experiment, or if it yet has crystallized; but at any rate it was clean promotion and a sporting way of doing mining business. And there is much more mining business done along these lines than is realized. Most of it is financed privately and with a clear notion of chances to be taken and before-hand acceptance of the outcome, favorable or otherwise. Such cases are not celebrated; we do not commend them in our columns, because we never hear about them. The headlines in the metropolitan dailies do not herald the discovery of a man who is living happily with his wife, or is working his head off for an aged mother. These things are far too common to have news value. They chronicle the discovery of the man who has poisoned his wife and six children or who is suing his mother in the endeavor to deprive her of his father's estate.

What the Mineral Industry Has Done for Geology

AT A RECENT MEETING of the American Association for the Advancement of Science, held in Boston, Dr. Willet G. Miller, of Toronto, discussed "Geology's Debt to the Mineral Industry." He pointed out that the debt of the mineral industry to geology had now become generally recognized; but that what the industry had done to advance geological science had not been recognized by geologists; and that geologists and the mining engineers still lacked a full mutual understanding and appreciation. He quotes Sir Charles Lyell as to the beginning of active progress in geological science:

> "The phenomena observed in the structure of the globe had hitherto served for little else than to furnish interesting topics for philosophical discussion: but when Werner pointed out their application to the practical purposes of mining, they were instantly regarded by a large class of men as an essential part of their professional education, and from that time the science was cultivated in Europe more ardently and systematically."

The presentation of this paper by Dr. Miller was timely. A class feeling, with the corresponding inevitable feeling of superiority, still exists, between the mining engineers and geologists and what we may call the academic or cloistered geologists. Each group feels ultimately superior to the other, a sure sign of insufficient enlightenment and mental provincialism. If our own editorial attitude reflects something of the general spirit which we have ascribed to the former group, it will only prove the truth of our generalization. The relationship between unapplied and applied geology has been with more or less humor phrased as that between pure geology and economic geology; but it is quite possible that economic geology shall be as devotedly and rigidly scientific as that geology whose problems have not been stimulated by economic considerations.

If the mining men have small respect for those geologists except the specially trained ones that speak their own language and know their necessities, on the other hand the academic geologists have small conception, as Dr. Miller points out, of the contributions to geology which mining has afforded.

The ordinary dweller on the face of the earth has little curiosity as to the subsurface of the earth. His is a two-dimension mind, and all his curiosity effects only the phenomena of the surface. A foot of plowed soil represents the depth of his thoughtful imaginings. But the miner, with his tunnels, shafts, and crosscuts, thinks in three dimensions. He is transported to an older and a more complex and silent realm, as the astronomer is, among his stars. It is the miner, whether he be engineer or not, who constitutes the avid and intelligent audience, the natural field for a sort of university extension work, for the geologist—not the surface dweller, wise with the superficiality of the surface conditions though he may be. Thus among the older societies, the American Institute of Mining Engineers has had a keener and broader interest in the ultimate geology of the under-earth and has offered a wider and more eager audience than any other society —a fact which is totally unappreciated and even unknown to many of the cloistered group of geologists.

Dr. Miller observes, "Probably one criticism that could be made of the geologists of the present day is that they do not nearly so much to popularize their science as did their predecessors in the last generation." The remedy for this fault of pedanticism lies in plain talk to the natural group of disciples, the workers in the mining industries; for through this group the enlightenment of the surface laity will be most easily reached.

One compliment which Dr. Miller paid deserves to be flung back, as honestly as it was given. He says, "A Canadian may be permitted to say that the geologists of the United States occupy a pre-eminent place in the world." Frankly agreed to; but it is a thought that had come to us long before reading Mr. Miller's tribute, that, considered on a basis of population, Canada certainly stands in no inferior position, and probably in the foremost place.

The Chamber of Commerce and Trade Associations

BUSINESS MEN as a rule fear, above all other regulations and rules established by the government for their conduct, the Sherman Act. It acts like some gigantic policeman in whose shadow they are moving, and who constantly moves to prevent them from gaining the sunlight. The Sherman Law is an effort to provide free and open competition among the manifold industrial enterprises of the United States, but there is no denying the fact that it sometimes goes to the other extreme and encourages ruinous competition which ultimately benefits no one. To mitigate the evils of cutthroat and merciless competition, to improve their lot, and at the same time benefit consumers, manufacturers and others have banded together in trade associations, organizations that have grown tremendously in the last ten years. But owing to the uncertain interpretation of the laws covering collective activity and the occasionally obvious abuses of the privilege of commercial association, many business men remain in a quandary as to the exact field of a trade association—just what it should do and what it shouldn't.

The Chamber of Commerce of the United States of America, an alert and vigorous body, is using its mem-

bership and resources to shed light upon the problem. In a "Referendum No. 41" it is submitting to its individual members a report of a committee on trade associations which was appointed to study and report upon the subject. This report is excellent and valuable reading for anyone interested in the question and presents in a clear and concise form the arguments for and against the various functions of trade associations.

To obtain an accurate index of the opinions of its members the Chamber has included with the report a ballot asking a vote on eight important points. Thus it asks if trade associations should exist for each important branch of industry and commerce; if the membership should be representative of the industry in connection with problems affecting its general advance; if the membership should be prepared to consider all problems affecting the general advance of the industry; if trade associations should be free from special forms of government control; if statistics of capacity, production, stocks, and sales should be collected by them; if statistics of actual prices in closed transactions should be gathered; if interpretation of statistics or other comment which would induce or facilitate concerted action by members should or should not be omitted; and if statistics should be made available to the public and the interested government agencies.

These questions, of peculiar and yet momentous importance to American industries, from the manufacture of chewing gum to the smelting of lead, deserve and doubtless will receive careful and increased attention on the part of the members of the Chamber of Commerce. The outcome of the balloting on the referendum will be available soon, and besides furnishing a guide for the direction of the Chamber's energies with regard to trade associations, will supply a priceless analysis of the feeling of the American business man toward an activity which promises to help him materially in his worries and tribulations. The entire subject of the work of trade associations is still so clouded with controversial discussion that it will be refreshing to have the record of a vote from industrial representatives who are most affected by the organizations and who have their welfare at heart.

Taxation of Tailing

IS MILL TAILING, for purposes of taxation, to be considered part of the mine from which the ore that contained it has been extracted, or is it personal property distinct and apart from the mine? Out in Utah the Utah Copper Co. and the officials of Beaver County advocate the first theory, whereas the South Utah Mines & Smelter Co. and Salt Lake County contend for the contrary view. The Utah Copper mine is in Salt Lake County; it is protesting taxes levied on the assumption that the tailing from its mills at Garfield is personal property, a term that includes all tangible assets other than land or real estate, and permanent buildings or other structures on the lands. Warehouse supplies and equipment, stocks of coal, cement, and other commodities are classified as personal. The South Utah company owns copper mines at Newhouse, in Beaver County, and is protesting taxes levied on the assumption that tailing from its old concentrator is part of the mining property.

The South Utah case was argued before the Supreme Court at Washington last week and the Utah Copper case is now before the U. S. Circuit Court of Appeals. The circumstances of the two suits are these: The South Utah company accumulated about 900,000 tons of copper-bearing tailing at Newhouse prior to 1914, since which time nothing has been done on company account. In 1918 the Utah Leasing Co. erected a flotation plant to rework the dump, and with copper selling at 26c. netted $120,547. In accordance with the state law providing that a mining company shall pay a tax based on three times the value of the net proceeds, Beaver County, through the State Board of Equalization, levied a tax on $361,641 against the South Utah mine. The mining company contended that the tailing was separate and distinct from the mine and that proceeds from working it could not be construed as proceeds from the mine. The tailing had in effect become personal property and the Leasing company had become owner of such portion of the dump as it treated. It was argued that the tailing was comparable to a like quantity of sand used for making concrete.

These contentions conflicted, however, with various decisions that had been rendered in favor of the Utah Copper Co. in which the courts had supported the view that for purposes of taxation the tailing from the mills at Garfield is still part of the mine at Bingham from which the ore that produced it originally came. The assessor of Salt Lake County in 1917 had placed a valuation of many millions of dollars on the huge dumps below the Magna and Arthur mills; these the mining company admits will in all probability be re-treated for a substantial profit and are today of great value. The company maintained, however, that the tailing for purposes of taxation should be treated exactly as if it were ore in the mine, and that the tax on three times the net income paid by the company each year included any tax due on the tailing. The Salt Lake County assessor argued that as soon as the ore was removed from the mine it became personal property and was subject to tax as such.

A further question raised in the case is whether Utah's constitutional amendment providing for the basing of the assessment levied against a mine on a multiple of the net proceeds for a given year is in conflict with the Federal Constitution. A number of other states use similar methods of arriving at a basis for taxation, so that the decision in the case will be of widespread interest if the Supreme Court elects to determine this issue. The court may decide the question of constitutionality or it may settle the suit on the other issue only.

The question as to whether tailing that has passed through a mill should still be considered, for taxation, as being virtually part of the ore in the mine offers an inviting opportunity for those who enjoy ponderous, even if futile, speculation. What of ore newly delivered at the mill; or ore on the mine dump; or broken ore in the stope? Suppose that the tailing were marketable for road material. Would it then be taxable as part of the mine or as personal property? On the other hand, what of the concentrate, and the blister copper? When, if at all, does the valuable product become taxable as personal property and not as part of the mine? The contention, of course, disappears if the phrase "for purposes of taxation" is deleted. A man owns an automobile which he would not think of selling for $2,000, but he will try to convince the tax collector that it is worth about $200 for purposes of taxation.

Terms of Precision

By T. A. Rickard

THE recent discussion of the term "ore in sight" recalls many past controversies on the subject, and it brings to mind again the fact that much confusion is caused in mining by the slipshod use of technical terms, which essentially are terms of precision. In 1902, after a lengthy discussion of the term "ore in sight," the Council of the Institution of Mining and Metallurgy (London) requested the members not to use the phrase in their reports "without indicating, in the most explicit manner, the data upon which the estimate [of ore] is based." In making this recommendation it was stated that the term "ore in sight" is used to indicate "two separate factors in an estimate" —namely, (1) ore blocked out, that is, exposed on at least three sides "within reasonable distance of each other," and (2) ore that may be reasonably assumed to exist. The Council insisted that these two factors should be kept distinct, because the first was governed by fixed rules, whereas the second was "dependent upon individual judgment and local experience." The result of this official pronouncement was to discredit the term "ore in sight" and to encourage the use of substitutes. Of these the series "positive," "probable," and "possible" is most in favor. The diminishing degree of certainty, grading into complete uncertainty, suggested by these adjectives was indicated by using "positive" for ore blocked out on three sides or more, "probable" for ore visible on two sides, and "possible" for ore the extent of which was dependent chiefly upon the exercise of the imagination, either carefully by a competent engineer or carelessly by an unscrupulous promoter.

The fact is that the actual significance of any term or phrase used to indicate the varying completeness of evidence concerning the amount of ore in a mine is dependent upon the nature of the ore deposit and the professional experience, either local or general, of the engineer that makes the estimate. When employed by persons that are not mining engineers it is suspect, of course, because the significance of a technical term is contingent upon the correct use of it. A layman supposes that ore "in sight" means ore that is visible, and in that sense the ore is not in sight until it is in a bin at surface; indeed, even that is an assumption based on the supposition that it contains a valuable metal in such proportion as to become a source of profit after metallurgical treatment. The only sensible way to avoid misunderstanding is for the engineer to state to what degree the ore has been exposed, penetrated, and sampled. Then his estimate can be understood, and subjected to fair criticism, if necessary, by another engineer. It becomes a question how thoroughly the ground in a mine has been intersected by workings, and to what degree those intersections, or exposures of the lode, warrant confidence that a given tonnage of ore is assured beyond peradventure. The term "probable" ore needs little comment; obviously, the degree of probability depends upon the character of the deposit and upon the attitude of the estimator. "Possible" ore is a dangerous term, because it invites an unrestrained exercise of the imagination. One man's possibility is another's probability. When employed intelligently "possible ore" is equivalent to "future prospects." It is best therefore in using this term to say plainly what reasons exist for anticipating the finding of ore in ground that as yet is unexplored. Conventional terms are used too frequently in lieu of detailed description.

Coming back to "ore in sight," it must be noted that the word "ore" itself needs definition. Concerning this technical term also there has been much controversy, for it has been used so loosely as to render futile the attempt to define "in sight." One should not define terms in words that themselves need definition. The term "ore" has been discussed in the technical press more than once, and I confess to having been the instigator, because it has seemed to me essential to the self-respect of the mining profession that engineers should use such a basic term scientifically—which means with unmistakable truthfulness. Of the various definitions it may suffice to quote three. Von Cotta said sixty years ago that "ore" comprehended "all minerals and mineral aggregates which from their metallic contents attract the attention of the miner." That is the definition of a geologist, not an economist. The New English Dictionary (1905) defines "ore" as "a native mineral containing a precious or useful metal in such quantity and in such chemical combination as to make its extraction profitable." Here the idea of profit is introduced, as it should be, and with the idea of profit goes the idea of quantity, for the profitability depends upon the quantity as well as the quality of the mineral. Professor James F. Kemp recognized the distinction between the geologic and the economic meanings of the term. In 1909 he proffered the following: "In the scientific sense an 'ore' is a metalliferous mineral belonging to the group of those which have profitably yielded the metals to the miner or metallurgist. In its technical sense an ore is a metalliferous mineral or an aggregate of metalliferous minerals, more or less mixed with gangue, and capable of being, from the standpoint of the miner, won at a profit; or from the standpoint of the metallurgist, treated at a profit." This definition was good in that it was based on current usage, but it was, I submit, too indulgent. A correct estimate of profitability assumes both the miner's and the metallurgist's approval; moreover, being a matter of economics, it must be tied to time and place. Rock may be "waste" in 1900, but "ore" in 1920; metalliferous material may be "ore" if situated close to a railroad and only "rock" if in a remote locality. Therefore, in 1914, I suggested: "Ore is metal-bearing rock that can be exploited to economic advantage." The word "economic" serves to warn geologists, chemists, and journalists to tread warily; it includes the limiting factors of time and place.

Another troublous term is "low-grade ore," which is used both for ore that yields a small profit and for rock that is expected to come within the category of "ore" when conditions improve, for example, in consequence of cheaper treatment or a better market. Here again detailed information should replace conventional terms. In South Africa the managers report reserves of "unpayable ore," meaning stuff that at some future time may perhaps be exploitable at a profit. Such terms are ridiculous. "Near" ore is not so bad; it is significant, if humorous; but it is better to be humorous than ridiculous. "Pay" ore is emphatic, so is "commercial" ore; but neither is needed if "ore" be used discriminatingly.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

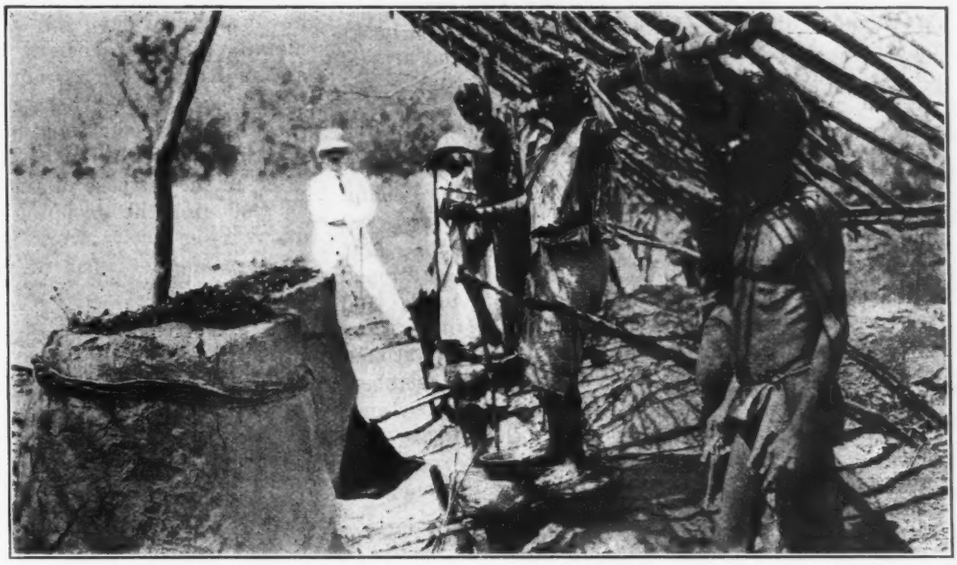
Ancient and Modern

Primitive Methods Still Effective in Iron-Smelting Operations in India

THE EDITOR:

Sir—In these days of quantity production it is hard to believe that our modern blast furnace had its beginning in such a crude affair as Mr. Manchester describes in "An Illustrated History of Mining and Metallurgy," recently published by the *Engineering and Mining Journal-Press*. It is perhaps still more surprising to find in use today furnaces of almost the same type as that described on p. 411 and illustrated on p. 413 of the Sept. 2, 1922, issue.

In one of the native states of India (Mayurbhanj) I found a battery of two furnaces, shown in the photograph, working. They were made of dried clay, and each had two foot-bellows almost exactly like those described by Mr. Manchester. These bellows were small cylindrical clay pots covered with goat skin, each with a bamboo pipe leading into the furnace. The only point of divergence from the one of 3,500 years ago seems to be the method of elevating the goatskin after it had been depressed by the foot. This was done, instead of by lifting the skin with a cord by hand, by a bowed piece of wood acting as a spring to give the upward tension. A hole in the skin, which was shut by the heel on the downward stroke, permitted air to enter when the heel pressure was released, without sucking through the furnace. This old-time process has undoubtedly been used by the native smelters of the country for hundreds if not thousands of years.



Battery of two furnaces using foot bellows, Mayurbhanj, India

The charge for these furnaces is finely broken soft iron oxide ore (limonitic) and charcoal. As is usual in India where the working unit is the family, all able-bodied members convene to work the bellows. I understand that about 50 lb. of a very malleable iron is produced in a day's work.

Westkill, N. Y. HENRY J. VOLKER.

Membership in the Institute

THE EDITOR:

Sir—During the last few years I have noticed the growth of a general spirit of resentment among mining and metallurgical engineers that memberships in the American Institute of Mining and Metallurgical Engineers should be extended to applicants who are in no way vitally interested in either mining or metallurgy or in any closely allied industry. There is even some tendency to make light of the Institute by comparing it to certain well-known organizations and societies, admission to which requires only the payment of a fee and dues. My discussions with engineers do not indicate a merely disgruntled attitude toward this subject, but rather that there is a feeling that the Institute is not serving the purpose for which it was founded.

Some of the many questions raised and probably the most outstanding in frequency are: What is the purpose of the American Institute of Mining and Metallurgical Engineers? What should be the purpose of such an organization? What has the Institute done in the past? Who are its members? Where are these members? What portion of its members are interested in mining or metallurgy as a profession or industry or due to activity in some closely allied industry? What portion of its membership is not interested vitally in the avowed purpose for which it was organized? What do members actually receive for their initiation fee and annual dues? Why is the headquarters of the Institute maintained in New York City? What is the geographical distribution of its members of all sorts? Of its members actually interested in mining or metallurgy?

The purpose of the Institute is admirably stated in its Articles of Incorporation. There we find that it was organized "to promote the arts and sciences connected with the economic production of the useful minerals and metals, and the welfare of those employed in these industries by all lawful means; to hold meetings for social intercourse and the reading and discussion of professional papers, and to circulate by means of publications among its members the information thus obtained, and a hall for the reading of papers and delivery of addresses, and a library of books relating to subjects cognate to the sciences and arts of mining and metallurgy."

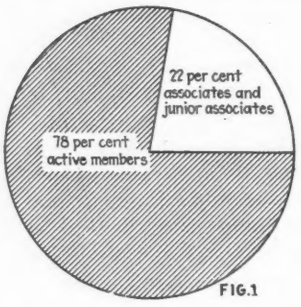


FIG.1

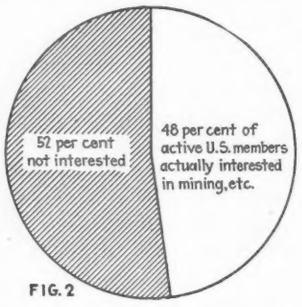


FIG.2

Fig. 1—Showing proportion of active Members to Associates and Junior Associates. Fig. 2—Showing, out of total active Members, the proportion actually interested in mining.

If the present purpose of the Institute is in harmony with the above statement it should certainly be more than a membership seller. Size will not make it powerful or effective. Instead of all members being continually prompted to comb their localities for possible new members without much regard for their interest in Institute affairs, they should be cautioned to investigate the possible prospect thoroughly and present only those who would be able to understand and contribute to its purpose. The National Geographic Society has an exceptionally large membership, but there is some question as to its importance and power as an organization. If the Institute continues to develop along the lines of that society it may eventually be possible to secure a membership in each at club rates.

Most engineers feel that either the membership requirements are too lax or are not being properly applied. Interested members resent memberships being extended to "collectors" or "joiners" or to others who are admitted, possibly, to swell the treasury. In the February issue of *Mining and Metallurgy* there were published the names of eighteen applicants for regular membership in the Institute. These eighteen were divided as follows according to their work: One petroleum engineer's assistant, three industrial representatives, two government (foreign) employees, three from the coal industry, one coal-mine promoter, one iron-mining engineer, two from general practice of engineering, and five interested in the mining or metallurgy of metals. Is this indicative of anything? Only 27 per cent of the incoming membership for that month are interested in mining of metals and only 50 per cent interested in mining of any kind—coal, iron, or non-ferrous metals. Is it not time that we gave serious attention and consideration to this matter of membership? It would seem a wiser policy, if we are to be truly representative of the mining industry, to make a real effort to reduce the membership to actual mining men than to expand it to embrace everyone who can be induced to pay the initiation fee and dues.

If the membership of the Institute were composed of, say, mining engineers, metallurgical engineers, geologists, mine owners, operators, and professors, with a common requirement that every applicant and member be actually interested in some contributory manner with the mining of minerals or metals, there would be more unity of purpose and interest in the organization itself. Under this plan many of those who become members with the idea of "getting" only would be eliminated. A cursory examination of the year book shows that in addition to the above classifications there is a surprisingly large percentage of the membership made up of representatives from all sorts of more or less foreign interests. Some of the classifications noticed are: patent attorneys, automobile manufacturers, metallurgists, ceramic engineers, electrical engineers, wood-preserving specialists, iron and steel manufacturers, mining-machinery manufacturers, machinery salesmen, powder manufacturers, surveyors, salesmen of various kinds, construction contractors, rubber manufacturers, insurance men, foundrymen, purchasing agents, safety engineers, hardware men, bond and stock salesmen, chemists, soap manufacturers, financiers, promoters, oil-shale experts, and numerous others not identified with mining or metallurgy. Now, there may be nothing wrong with these men or their work except that most of them are "in the wrong church" and are not particularly interested in the purpose of the Institute. Provision might be made for the dropping of any member who withdraws from active work in some accepted activity to take up another form of work that would be foreign in its nature, and for his reinstatement in case he should return to an accredited activity. This would not affect those members who might retire from active life because of advanced age or disability and whose participation in Institute affairs might be found to be very valuable. In this manner dead timber could be largely eliminated and the organization kept in fighting trim.

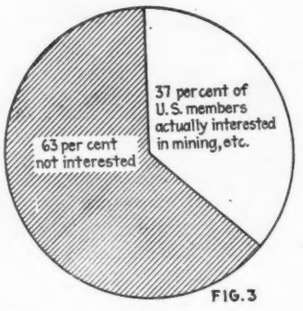


FIG.3

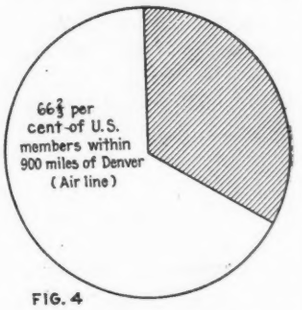


FIG. 4

Fig. 3—Showing (by combination of Fig. 1 and Fig. 2) the proportion of Members in the United States who are actually interested in mining. Fig. 4—Showing proportion of Members in United States who are within 900 miles of Denver.

An organization that exists to serve mining and metallurgical interests cannot profitably devote its at-

tention to forms of engineering that are not interesting or helpful to its members. Mention should be made of foreign subjects only as they affect the main issues. Ample information for general purposes may be gained from general reading and particular information may be secured from special sources if it is required, without the Institute wasting valuable time and space trying to meet the needs of an indiscriminate membership. Certainly, dissertations on methods of mining ores or the metallurgy of gold or copper would be uninteresting and without profit to men who rightfully belong in the National Association of Sand and Gravel Producers. Yet these industries have some points of common interest. Discussions of grinding methods and costs at some of the large mills or the effect that certain methods of ore reduction might have upon subsequent treatment would be of even less interest to members of the American Concrete Institute. Nevertheless, the industries represented by the above-mentioned organizations employ many methods and some equipment in common with the mining industry. Is it, then, too much to predict that the possibility of interesting mining and metallurgical engineers in paving methods or other subjects not intimately associated with their regular activities is, at best, remote?

There has been considerable comment on the actual value to the members of the Institute's official magazine, *Mining and Metallurgy*, for which all members are arbitrarily charged. Opinion indicates that there is no excuse for such a magazine, because there already exist technical papers and magazines that amply fill the need. There are, of course, many contributions to *Mining and Metallurgy* by competent and well-known engineers, but most of the vital and highly interesting material goes to the technical magazines. The last issue of this magazine contained probably only one article that the average mining or metallurgical engineer would read. Many engineers actually leave their copies of *Mining and Metallurgy* unopened. If subscription to it were voluntary it would, in all probability, not be published. I realize that the reason for the forcing of the subscription upon members is to get the second-class postal privilege, but would it not be fairer to them to let it be voluntary? I venture the prediction that it would suspend publication at once. Certainly if it does not fill a need it has no place in the proper conduct of the Institute. On the other hand, the *Transactions* of the Institute are generally considered valuable, and most engineers welcome them. Owing to the cosmopolitan membership, considerable matter gets into them that is not of interest to mining or metallurgical engineers, but this can be remedied only by regulating the membership and confining it within proper bounds, and a more careful editing of the material that goes into their make-up.

As to why Institute headquarters are maintained in New York City no one seems able to give a better explanation than that they have always been there since its organization and no attempt to remove them has been made. Even if the location of headquarters were determined by the geographic density of membership, without regard to classification, New York City could not qualify as the logical place for it. However, if we were to place the headquarters near the geographic center of density of members actually interested in mining, it would probably be either in Denver or Salt Lake City.

A count of the members of the Institute who are actually engaged in some work pertaining to mining, both ferrous and non-ferrous mining, metallurgy, oil production, and coal mining, resulted in some interesting facts being brought out. No count was made of any member unless information was given as to his activity. An interesting indication of the geographic distribution of members, based on the 1921 year book, is given below:

Miles Radius From Center	Number of Members Actually Interested in Mining, Metallurgy, Oil, Coal and Iron Within Varying Radii From Denver	From New York
300	288	750
600	928	832
900	1,674	996
1,200	2,042	1,206
1,500	2,452	1,356
1,800	2,804	1,622
2,100	.....	2,118
2,400	.....	2,490
Over 2,400	.....	2,804

It hardly seems logical to maintain the head office of such an organization at such a distance from the center of density of the membership actually interested in its avowed purpose and so far from the center of activity of the industry it represents. The above comparison indicates that there are more interested members of the Institute within 900 miles of Denver than within 1,800 miles of New York City. The whole membership, with the exception of those in foreign countries other than Canada and Mexico, is within a radius of about 1,800 miles from Denver.

Because of the nature and purpose of the Institute its headquarters should be maintained in the West. Would the Portland Cement Association locate its main office in San Diego or Los Angeles? The officials would enjoy living at either place probably, but to consider such a location would be foolish. The principal mining and metallurgical activities in the United States occur mainly west of the Mississippi River. The organization that champions these inherently western industries and those engaged in them should be located in the West and should have, in so far as is consistent, western officials.

This discussion does not in any way involve the ability of any of the officials of the Institute or raise any question as to their sincerity of purpose, the contention being, simply, that for best results the heart of the organization be located in the proper place, and not in the foot or hand.

I am hopeful that this contribution to your "Discussion" columns may be productive of an open discussion of this question, which impresses me as being of vital importance to the industry at large. Are we to follow the present policy and build up a great heterogeneous membership composed of anyone who has the slightest interest, selfish or otherwise, in our industry, or are we to make of the Institute a body representative of the great American mining industry and remain true to the purpose of the founders? I am one of the many in favor of the latter course.

In making the accompanying diagrams the percentages were arrived at by counting as accurately as possible the names in half of the 1921 year book and applying the result to the whole. I believe that it will be found fairly accurate even as applied to the present situation. If anything, the percentage of actively interested members has decreased, due to the membership campaigns taking in anyone who has the "admission."

D. H. FAIRCHILD.

Chicago, Ill.

Boston & Montana

THE EDITOR:

Sir—My attention has recently been called to statements made in various publications that I endorse and recommend the purchase of Boston & Montana shares. Inasmuch as I have not examined the property for over two years, I see no reason to change the opinions expressed in my full report on the company's property made in 1920. That report has never been published and the selected extracts made from it do not correctly express my conclusions or opinions.

New York, N. Y. WALTER HARVEY WEED.

The Asbestos Trade of India

THE EDITOR:

Sir—The asbestos wealth of India has not yet been systematically explored. From what I have seen personally, I am fully convinced that it is considerable and worth exploiting. Personally, I would like to see American capitalists come out here and develop the resources. But there is one drawback. Under the new mining rules framed by the Government of India, it is impossible for non-Britishers to secure any mining concessions. But to the determined man, loophole can be found to every obstacle. Until now, the biggest asbestos belt has been in Saraikela. The next largest field is in Mysore. Both these fields have already been acquired by Indians, who are doing nothing, however, to develop them. But they are not to blame. I shall now disclose what I believe to be the real cause of their failure.

Certain European firms in India, who deal in asbestos goods, have a sort of secret understanding to the effect that they will completely monopolize the asbestos trade in this country. They will buy from the Indians at a low price, send the stuff to England, and bring it back in the shape of finished goods, which will be sold at fancy prices, so to speak. Now, it takes a lot to raise, wash, and, in short, make the crude asbestos marketable. The sellers find that asbestos sells at high prices, but wonder why their stuff does not fetch good prices and why the buyers offer low prices—so low, in fact, that the margin of profit is small.

It may be urged "Why not export to England or America?" "Ah, there's the rub." The members of the ring have taken care that good prices are not obtained there. They are being backed by certain firms in those countries. The rest may easily be understood.

It may also be urged "Why not manufacture asbestos goods in India and sell them at prices lower than those charged by the ring?" True, but the difficulty is this: The Indian buyers will not back any such enterprise. They will prefer to pay the foreign sellers' (high) prices, but will quote a low price to the Indian seller. The clique will also operate. Further, Indian financiers fight shy at new enterprises. They will pursue the beaten track, but when it comes to a new line, they sit down to think and think—result, nothing. So I do not expect any help from Indian financiers.

True, the American financier will not be able to secure any asbestos mine; but if he will secure sole agencies, manufacture the goods in India, and sell them here or at home, then alone a systematic exploitation of the asbestos wealth is possible, as he will know how to sell to advantage. The ring will not be able to do him any harm.

I am sorry to say that financiers out here have not yet realized the utility of asbestos. This defect is due to lethargy and want of mining enterprise. Mining education must be spread, if the potential mineral wealth of India is to be fully exploited. The government is doing what it can in this direction; but it has no large funds. The Indian financiers, to my mind, will awake if they see an American capitalist developing the asbestos wealth. Then I believe there will be a rush, before which the ring will be swept away. That day is far distant. But I should not be surprised, if, one day, some American financier comes here and starts operations on a large scale. Attempts will be made by the interested parties to send him away; but if he sticks to the business he will not have any cause to regret. A small capital will not do. At least $100,000 must be invested to start with. I would advise the formation of a syndicate, with offices in India and America. As labor is very cheap here, it will be possible to manufacture goods cheap. S. B. BANERJEA.

Calcutta, India.

Heresy Hunting in Geology

THE EDITOR:

Sir—Mr. Malcolm H. Bissell's breezy letter in your issue of March 3 seems a splendid illustration of how easy it is to burlesque a new and unfamiliar idea. Doubtless he wishes to put into use his doctrine, which he enunciates in this letter, that it is easier to be clever than to be wise.

About a year ago, Mr. Bissell happened to read my "Poisoning Democracy," one of my books dealing with socialism. In this book he ran across some remarks about the theoretical interpretation of thrust faults and disconformities which he thought smelled of geological heresy. From that time he has been writing me quite voluminous letters; and now he has transferred the correspondence to the columns of the technical journals.

In one of his first letters to me, he accused me of being "probably too old" to change my ideas. I had to confess that I was probably studying geology before he was born; but that in this matter of our relative ages he had a very decided advantage over me; for he could look up my name in "Who's Who" and see my exact age, while I could not find any such data about him.

I suppose I ought not to object to his giving such a picturesque advance notice of my forthcoming "The New Geology, a Textbook for Colleges." But there are various ways of making such a preliminary announcement. His method is like that of a man who marches down the street accompanied by a brass band, and saying: "Here comes a man with a bad book, a very bad book; he's a fool and a charlatan; don't buy his book." Naturally, an author hardly craves such an announcement.

Why didn't Mr. Bissell wait until this *textbook* is out which he says is to destroy the whole science of geology? He could then criticise it to his heart's content. But youth is impatient, and three months seems a long time to wait. In the meantime he is getting some most excellent practice at writing on his own account.

Mr. Bissell is undoubtedly clever. He would have made an admirable writer of light comedy; or he might have succeeded as a prosecuting attorney. However, in the latter capacity he would have been inclined to arrest and prosecute before the crime was committed.

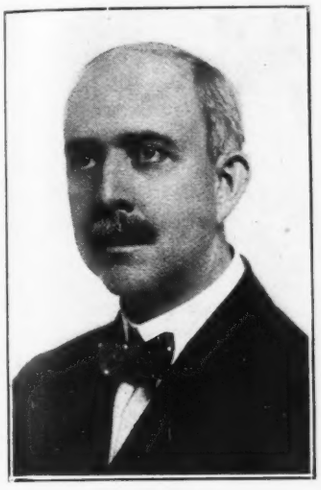
College View, Nebraska. GEORGE MCCREADY PRICE.

Burma and the Bawdwin Mines*

Geography—Mineral Wealth of Burma—History—Housing of Labor Is Relatively Simple—Sanitation a Difficult Problem—All Labor Is Imported and Principally Asiatic

By R. G. Hall

Late Resident Manager in Burma, Burma Corporation Limited



R. G. Hall

THE BAWDWIN group of mines is 600 miles by rail from Rangoon and in the State of Tongpeng, one of the Northern Shan States of the Province of Burma, Empire of India. These states are governed by hereditary native princes, Sawbwas, who are supposed to be independent of each other, and to be independent of the Provincial Government except in respect to highways, railways, and defence. The representative of the Provincial Government, known as the "superintendent," is virtually the government. The laws, excepting tribal customs, are initiated and enacted by the superintendent, under the direction of the Lieutenant Governor of Burma and his advisors. The title to land vests in the Sawbwa, and absolute fee cannot be acquired. A property lease, subject to annual rental, can be obtained for approved purposes for a limited period. Water-powers can be acquired subject to an annual ground rent for the surface occupied, and also to an annual charge that is generally based on the amount of power developed, all payable to the Sawbwa or state revenues.

Mineral deposits, including coal and oil as well as precious stones, are disposed of by the Provincial Government and not by the Sawbwa. The royalties do not, at present, accrue to the Sawbwa or the state but to the Province of Burma. The royalties on iron ore are specific, but those on most other minerals, except precious stones, are ad valorem. Consequently, on such ores as those of the non-ferrous metals and silver, difficulty may arise in fixing the "pit-mouth value." This is generally decided by paying an agreed per cent of the market value of the metal contents.

The forests are reserved by the Provincial Government and are principally worked on a royalty basis, the proceeds accruing to the Province of Burma. Certain rights to minerals, especially to the precious stones of the "Ruby Mines" district, are reserved for the natives, and leases are generally granted subject to these reservations. In the forests sufficient wood for fuel and timber for house building is reserved for the use of the natives.

Topography limits the density of population. The part of the Shan States extending from the southern limits of the Himalayan uplift to lower Burma, and bounded on the east by Hunan, Indo China, and Siam, is largely mountainous and inaccessible. Toward the north the hills rise to altitudes of 10,000 to 12,000 ft. The valleys of the tributaries of the Irawaddy, Swehli, and Salween are from 2,000 to 3,000 ft. in altitude. Toward the central and southern parts the hills are not so high, and, although rough and rugged, the country is more accessible.

The Wa States, east of the Salween and lying on the Chinese border, have no representative of the Provincial Government, no communications, and no police. The people are said to be savage and uncontrolled, except for one or two places near the outer borders of the district.

Shans Are of the Mongolian Races

The local population of Shans and a few related tribes are Mongolian, probably representing one of the earlier migrations from Tibet. The Shans are found throughout the region, both in the Shan States on the west of the border and to the east in the Province of Hunan. On the south, in Siam, the population consists largely of Shans. The Shans are said to total 15,000,000. Those in contact with civilization are an ambitionless, indolent people. Their love of the low-lying river valleys explains much of their backwardness. The mosquito abounds in the valleys the year around, not only the ferocious jungle mosquito whose bite is terrific and hurts for hours, but also the anopheles. After the white has had a few bouts with the malaria germ, he begins to understand the apathy of the Shan.

A great variety of minerals occurs in Burma and the Shan States. Deposits of jade are in and near the Mogong district, on the far northern border on the Burma side. Farther to the east and on the Chinese side of the boundary, at the headwaters of the Taping River, are deposits of lead, silver, and zinc that have been worked to a limited extent in the past by the native population. More recently an attempt was made by a company, backed by American capital, to determine the extent and value of these and other deposits on the Chinese side of the boundary. At the time of writing, however, it was said that the prospecting work had been discontinued. Farther south, along this border, are deposits of complex lead, silver, and zinc ores. Slag heaps of considerable extent and similar in general character to those which led to the first European interest in Bawdwin are in the Wa States. Deposits of similar character are known to exist on both sides of the border, and undoubtedly, in the future, improved transportation will make profitable the exploitation of some of them.

The sands and gravel at many points along the Swehli River and some of its tributaries yield small amounts of placer gold. In the Northern Shan States, from the upper reaches of the Irawaddy above and around Mytkyina, many of the creeks and river beds give good gold indications. Several attempts have been made to work the more promising by means of dredging, but

*The first of four separate articles upon the Bawdwin mines. The remaining three will appear in subsequent issues.

Native bazaar

without success. It is reported that another attempt is soon to be made by a concern adequately financed and under the direction of competent engineers.

The Burma ruby mines are in the northern states. This district is tributary to the village of Mogok. Upon a limestone bedrock, associated with residual clay and gravel, have been found some of the most famous rubies and sapphires in the world. The precious and semi-precious stones found include practically every variety of corundum minerals except the emerald, as well as magnificent specimens of spinels, topaz, beryl, and similar stones. The digging and washing operations are conducted by a British company, subject to certain rights of the natives.

Iron Ore Deposits and Oil Fields

Deposits of iron ores have been discovered in Hsipaw and neighboring states within recent years. These for the most part are limonite, and the better grades contain from 55 to 60 per cent iron. The deposits overlie the limestone and are residual. They are found upon the surface mixed only with residual clay and earth and are a desirable and cheap flux for the lead ores of Bawdwin. Deposits of hematite are also known, but have not been exploited.

Farther to the south in the Southern Shan States many small deposits of galena are found in limestone pockets, but none, up to this time, has been proved of value. Specimens of cassiterite are frequently found, and at least one attempt has been made to exploit a deposit of tin on a modern scale. It has not yet proved successful, and I believe it is not being operated at present.

The oil fields of Yennangyaung lie between Rangoon and Mandalay on the west of the Irawaddy, in Burma. These have been producing for many years and are of great importance. It seems probable that other undeveloped oil fields may exist in Burma, and this industry may continue to be a large and growing one.

Large deposits of bituminous coal are unknown in Burma or the Shan States. Two points in the Northern Shan States show coking and semi-coking bituminous coal of fairly good grade, but the deposits are not large in extent. More deposits may be found. Lignite deposits are large and widely distributed. For the most part, so far as known, the lignites are high in ash, and at present are of slight value. One or two deposits, as that at Na Ma, not far from the mines at Bawdwin, are high-grade lignite and of value. Except for the railways and the smelting operations incidental to the Bawdwin mine, the demand for industrial fuel is small.

The tungsten and tin mines of Tavoy are in the Tennasserin district, in lower Burma. These were of great importance during the war and contributed heavily to the British supply of tungsten. The subsequent drop in price of both metals caused the present suspension of most operations in that district. Many of the owners have accepted the changed conditions and have shut down their properties to await better times.

The foregoing summary of the minerals of Burma and the Shan States is not exhaustive. I have seen specimens of graphite, molybdenite, cinnabar, and other minerals and have heard of large deposits of each. The topographical character of the Shan States—high hills covered with wash and soil to a depth of many feet and overgrown with a dense cover of trees, vines, bamboo, and other jungle growth matted and tangled in every direction—makes prospecting difficult or impossible. Only along the rivers and in a few places is there any open geological record. The country is inaccessible except within the railroad zone. Roads are almost unknown, and such as exist are impassible during six months of the year. The population is primitive and indolent. The jungle is unhealthy for everyone, but is

especially dangerous for the European, not because of the ferocity of men or beasts—for the latter appear more dangerous than they really are—but because of the malaria-bearing mosquito, and the germ-laden water one is obliged to use in the jungle. These are not remote and possible dangers, as in civilized countries today, but are ever-present menaces, against which guard must never be relaxed. Nevertheless, the country will be opened gradually. Under the enlightened administration of the Lieutenant-Governor of Burma, Sir Reginald Cradock, roads and railways are being built, agriculture is extending and being improved, and industry suited to country and climate is encouraged.

Early History Antedates Discovery of America

Unfortunately, the early history of the Bawdwin mine, probably antedating by many years the discovery of America, has become lost in the changes of more recent times. Inscriptions on certain monuments show that there was a population in the vicinity engaged in mining during the early part of the fifteenth century. In certain literature, references made to the source of the silver used in China, as early as the twelfth century, indicate that silver was obtained in this locality at that time. So far as can be learned at present, the Bawdwin deposit appears to be the most extensive of all of the ancient workings, and, judging by the tenor of lead in the slags remaining from former operations, the Bawdwin ores were probably richer and more easily worked for their silver contents than similar ancient deposits in neighboring regions.

Previous to European operations, during the Chinese

Shans

occupation, the production of silver was the important objective. During most of the early period the operations were at the instance of the emperor or the state. The presence of manacles on skeletons, and other evidences, would indicate that convicts or slaves might have been employed. At some time a highly developed military guard was maintained, but this seems to have had for its purpose protection from attacks from without rather than because of internal disturbances.

The entrances to the mines at that time were at an altitude of from 3,100 to 3,200 ft., and were along the course of the Sterne River. The reduction operations were carried out along this stream also, above and below the mine openings. The earliest were probably nearest the openings in the vicinity of the present mining villages. As the operations required large quantities of fuel, greater in weight and more difficult of

Palong women

transportation than the ores, the metallurgical plant migrated toward the fuel supply.

Reference was made to the presence of military forces at one time. Along the hilltops surrounding the ancient operations are to be found a system of military trenches so placed as to guard the workings from all attacks from the outside. The trenches follow in general the high ridges and face outward rather than inward. A system of cross trenches and relief trenches indicates a considerable degree of organization. It is probable that these military works were installed during and following the time of the Mohammedan rebellion of about 1851, and are merely evidence of an effort on the part of the government at the time to guard the source of its money metal.

The rebellion of the Chinese Mohammedans, or Panthays, marked the beginning of the end of Chinese occupation. The inroads of the savage tribes from the north, particularly the Kachins, began to make shipment of bullion into China increasingly difficult, and eventually caused the abandonment of the mine itself.

The passing of the Chinese ended the exploitation of the Bawdwin orebodies and work upon other mineral deposits in Upper Burma and the Shan States. In almost every instance, where mineral deposits of nonferrous metals have been found, there is also evidence of Chinese exploitation, and often of intelligent Chinese operations. The passing of the industrious and industrially trained Chinese left only the indolent and decadent Shan and the warlike and predatory Kachin, neither of whom attempted to produce metals from the Bawdwin ores on any large scale. The conquest of the country by the Burmese made only a change of masters. The feeble attempts at operation under the direction of Burmese were no more successful than those by the Shans. Silver in small amounts appears to have been obtained from the ores, and likewise lead, probably for ammunition, from the slag.

It has been supposed that the operations would have been suspended in any event, owing to the large flow

of water and the increasing depth of working. No doubt these difficulties would, in the course of time, have caused total suspension had operations been carried on along the lines of the work of the time. Chinese workings have been found as deep as 170 ft. below the lowest-known drainage level of that time. The water produced from such a winze was not inconsiderable. However, possibilities for draining the orebodies by adits, by no means beyond the skill and ability of the Chinese, existed, and no doubt would have been fully utilized as the necessity arose.

A Million Tons of Ore Extracted

Estimates based on the known extent of the workings indicate that as much as a million tons has been extracted. Owing to the small size of the workings and the ingenuities of the miners, it is probable that little

Native village

unprofitable material was mined. By the amount of slag recovered, and allowing for what must have been washed away during the rainy seasons, the total amount of silver won is estimated to have been as high as 10,000,000 ounces.

The modern history of the property is given in the *Mining and Scientific Press*, Vol. 119, p. 767. After the first discovery and exploitation by Europeans, the property failed to meet the hopes of its financiers and dragged along for a number of years. It was first given financial reorganization and competent technical direction under Herbert Hoover, and during his administration the property passed from a doubtful speculation to one of the foremost mining operations in the world. However, even the genius of Herbert Hoover was insufficient to preserve unity in the councils of the company, and when the war transferred him to a wider field of usefulness, an opportunity was opened to the financial adventurer and the stock-market operator. Technical plans by competent engineers were discarded to meet financial necessities.

Development of Weakness in Management

The result of these and subsequent financial mismanagement has been disastrous to the company. The points of weakness developed may be briefly summarized as follows:

1. Inadequate transportation facilities at the reduction plant. This has retarded developments for several years, and will prevent an adequate output unless remedied.

2. Inadequate reduction plant facilities, resulting in small output, wasteful metallurgy, and high cost. A proper plant was planned, machinery purchased, and foundations constructed. These, with other subsidiary improvements planned and carried out at a cost to the company of £250,000, were abandoned and scrapped, entailing in addition a much greater annual loss due to antiquated and inadequate facilities for operation.

3. Curtailment of the market for certain classes of zinc concentrates owing to the abandonment of a partly constructed plant for the manufacture of sulphuric acid and zinc. A direct loss of approximately £200,000 was made here.

4. Shrinkage of the corporation's securities. In 1919-20, these were valued at £14,000,000 (stock market valuation). The net result of the foregoing policy has been an increase of the nominal capitalization from one million shares of £1 each, or £1,000,000, to 14,000,000 shares of Rs. 10 in an Indian company. These have a nominal par value of about £7,000,000, but a stock-market value of 5s. each, or approximately a shrinkage from £14,000,000 to £3,500,000.

5. An issuance of 8 per cent debentures of £1,000,000, being a present fixed annual lien of £80,000 on the earnings of the property, and necessitating in the near future an additional annual sum of £200,000 for redemption requirements.

6. A legacy of distrust and suspicion in the minds of investors and technical men which will endure so long as any of those connected with the predatory policy of certain interests remain with the company in any capacity.

These elements of weakness have been discussed under history, as their detailing here may serve to explain why such a splendid property has been operating so many years with such poor financial returns.

The permanent working force is a minimum of 6,000. Beginning in November, the personnel is increased by the "dry weather" coolies, who do much of the outside work, such as forest felling, grading, and other duties.

The housing for the 6,000 is simple in character. The coolie, both Chinese and Indian, has never been accustomed to other than the crudest shelter. A long shed 12 to 16 ft. in width, with walls of stone, brick

or unburnt brick and a shed roof of corrugated galvanized iron suffices for all requirements. The shed is divided into cells, 12 x 16 ft., each with a door in front and a shutter in the back. An overhang of the roof in front provides shade and shelter for cooking, eating, and squatting during the period of idleness. Each cell will accommodate six or seven persons for sleeping, the customary number being four. No beds are used by any coolies, many of whom would not use beds if they had them. Certain tribes of Indians will not even sleep on a board floor, as their caste or their religion requires that they sleep on the ground. They generally have a blanket, as the nights are cold; sometimes during the winter the temperature is as low as 34 deg.

The better native labor uses a more commodious house. Generally, each man will have a cell or room to himself, but even among these there is an almost universal absence of bed, bedding, or means of comfort. As chairs and tables are likewise not used by the native Indians, of the laboring class at least, the furnishing is simple. Stoves or fireplaces are seldom seen; a few stones or bricks form a niche for the pot and a space for the fire. In fine weather this is outdoors; in bad weather indoors. Wood is the only domestic fuel. For foremen and clerical workers, who may be married, the houses contain two and three rooms. The walls of this type of house are made of 2 x 4-in. studding with a wall of bamboo matting; the roof, as usual, is of corrugated iron.

The European population is housed in frame bungalows, well finished and equipped. Roofs are now for the most part of teak shingles, and the houses are provided with large well-screened verandahs. Each house is built in a fenced compound, and supplied with pure water. Good gardens and lawns can be maintained where the tenant desires.

Until recently housing for both natives and Europeans was of the most primitive type and far from adequate. During the last four years, however, special efforts have been made to improve conditions, so that a better class of labor and supervisors might be retained. So far as living conditions are concerned, the average European lives in greater comfort than would be the case for a person of corresponding skill and salary elsewhere in the mining world. The native earns from two to four times as much as he ever did before, in either India or China, and on the basis of his own standards is adequately housed.

Sanitation Requires Thorough Organization

In a tropical country, and with an ignorant and much-mixed population, sanitary conditions require special attention. The company's staff has a chief medical officer and an assistant, both Europeans of high qualifications. A native staff is under them, centering largely at Namtu. Some of the native medical men compare favorably in qualifications with their European confrères. Altogether, there is a native staff of six graduate physicians, many native nurses, hospital attendants, compounders, and others.

There is a near-by native village of about 6,000 population, only a small portion of whom are company employees. For a small annual contribution of about Rs. 5,000, or $1,700, from the government, the company is obligated to supply medical and surgical attendance and medicines to all natives free of charge, as well as to give hospital accommodations. The company likewise provides sanitary service, and inspection for the public as well as its own employees.

Occasional outbreaks of plague and cholera occur. The last epidemic of cholera (in 1918) made it necessary to supervise closely the sanitation of the various camps and to take great precautions against further infection. As soon as there is an outbreak of contagious disease, especially bubonic plague or cholera,

Gurka milkmen

the chief danger arises from panic. The natives will flee and scatter into the surrounding jungle-covered country, contaminating all sources of water and food supplies and spreading the infection far and wide.

The sanitary department has charge of the water and milk supply. It has police powers from the state to enforce its rulings. The medical force is constantly on guard against the introduction of the plague-carrying rat. The rat can come only over the railway,

Jungle rest house

and means are taken to arrest its journey at the junction with the Burma railways. Quarantine against colon diseases—cholera, enteric and similar disease—is more difficult, as there are many gateways into the camps of the company.

The mode of living of the people is such as to invite epidemics. Sewage systems, outside the city of Rangoon, are unknown in Burma. Conservancy is by means of can and cart handled by the despised sweepers of

untouchable caste. Many of the native Indian tribes have caste scruples against the use of latrines or sanitary appliances, and all of them are, from their nature and education, convinced that such arrangements are, for some inscrutable reason, being imposed upon the Asiatic by the governing European.

The most prevalent disease of the Burma tropics is malaria. Mosquitoes are ubiquitous, big jungle fellows whose bite is as painful as the sting of a bee, and about as harmless, and the little anopheles, whose bite is hardly felt locally, but will speedily result in a few days of violent fever. The European population can be guarded somewhat by screens, but even this falls short of complete protection. The destruction and removal of the breeding places of these insects has done much to reduce the amount of malaria in the various camps, but complete immunity from the disease will be difficult to secure, as the jungle is only a short distance away and is inhabited by a fever-infected population and millions of malaria-bearing anopheles. The sanitary department has no sinecure. Among the population, many of whom are Mohammedans, a house-to-house inspection may subject the inspector to a more immediate danger than contagious disease. Women may now be free to see and be seen in Turkey, it is said, but the news has not yet reached the Indian Moslem, so far as I have observed.

The company has a hospital for natives and Eurasians. A hospital of ten rooms, under a European matron, is maintained for Europeans exclusively.

Commissary Provides for 15,000 People

The commissary department for a community of about 15,000 people is part of the company's business. A large amount of paddy (unmilled rice) is required for the jungle population. All supplies are brought in by the railway.

"Rice is rice" would be the opinion of most of us. On the contrary, rice, as we know it, isn't rice at all to the native Indian or Chinaman. After one has tasted the rice of the Shan hills, for example, one will agree that the over-milled, painted grain obtained in the grocery store does not deserve the name of rice. Unfortunately, there are many native tribes and there must be almost as many grades and kinds of rice. Rice constitutes nearly 90 per cent of the food of the southern Indians, and almost as great a proportion of the food of the Hunanese coolie. The northern Indian, as the Punjabi and Pathan, prefers wheat products (their countries are wheat-growing countries). The Chinese likes to supplement his rice with vegetables, and especially with a piece of fresh pork. It is said that a Chinaman, in Burma, at least, spends a larger part of his income on things to eat than any other element of the population.

The Ouriah, a tribe from central India, does the lowest, poorest paid work. His pay around the smelter will be Rs. 1 to Rs. 2, or 35 to 70c. He spends about 8c. daily for rice. His clothing consists of a cotton diaper made of a piece of white, or once white calico, about a yard and one-half long. His head is nearly covered with a puggaree of the same calico. This is a complete account of his food and clothes. He has no rent to pay, and not much of his wages goes for "movies." This represents living reduced to its simplest form, and this man will show a greater percentage of saving of his wages than any other person it has been my lot to deal with. I might mention that a "mali" or gardener employed by me personally told me that his cost of living was Rs. 5, or about $1.60 per month, and the remaining portion of his wage he sent back to his home. He was paid Rs. 35, or about $12 per month. He was a Gurka from Nepal, a Mongolian in race.

The natives higher in grade spent somewhat more on their clothing, but even with those of Indian blood, rice constitutes the staple diet. Although the Hindu will not eat beef in any form, he will eat other meat when he can get it, and most of those above the coolie class get a small amount. The Brahmin Hindu will not eat meat of any kind. The Mohammedan will eat anything except pork. The Buddhist, which sect may be said to include all Burmans, Shans, and border people, are forbidden by their religion to kill any animal under any circumstances, but they have no objection to eating any meat that someone else has killed.

Diverse Ethnological Elements in Labor Supply

A stock of imported groceries is kept for the European population. The commissary is operated with the view of earning 6 per cent per annum on the money invested in the business. It shows a loss more often than a gain. The volume of business is about Rs. 1,200,000, or $400,000, per annum. The company is the largest dealer in provisions in the province of Burma. It also conducts its own abbatoir and maintains sanitary supervision over such others as may be operated in the vicinity.

The Shans are essentially cultivators, and have no inclination for industrial work, with its requirements of sustained effort over long hours. They prefer to cultivate small patches of ground in the river valleys or on the low hillsides. This preference for the valleys has been a leading factor in the gradual decadence of what was once a much more vigorous and powerful people. It has been suggested that the malaria-bearing mosquito has modified the civilization in the past and is still doing so in many tropical regions. Perhaps in few places could more evidence in support of this viewpoint be found than among the Shans. Their villages and houses are in every case quite smothered in jungle growth. Few Europeans can make a trip entailing a night stay among such surroundings without an attack of fever. No one will deny the effect on the energy and ambition of the European of quickly recurring attacks of fever. The Shan seems to be a victim of these conditions in a most aggravated form. The few Burmese found in the hills are more vigorous and ambitious than the Shans, but the Burman dislikes the Shan hills, and his prejudice has a sound basis.

Substantially all labor is imported. General labor, railway maintenance of way, outside mine work, rough unskilled smelter work, and kindred jobs are mostly in the hands of members of certain tribes from peninsular India, such as the Ouriahs and Tamals of Dravidian stock, together with a few Mongolians from Nepal known as Gurkas.

Underground mine workers, smelter furnace men, and refinery men, in the more skilled jobs, are mostly Mongolians of certain of the border tribes. They are small in stature, but are intelligent and ambitious, and for that reason are more likely to be of Chinese than of Shan origin.

Mechanics, as machine shop workers, pattern workers, and others, are mostly from the Punjab, Sikhs and

Mohammedans. They are of almost pure Aryan stock, slow workers to be sure, but with most of the virtues and vices familiar to us at home. They are skilled workers in the mechanical arts. Most of them are ambitious; they live better than the southern Indians, and want their children to go to school.

Millwrights and house carpenters are Cantonese. This is the Chinaman that the West knew before the days of the Chinese exclusion. They are fair mechanics; some of them good. They like to take small contracts, not so large that they are unable to see the end. They are keen to make most advantageous terms for themselves in a contract and scrupulous to carry out terms once made.

The largest element of the labor force during certain seasons of the year is known as the "cold-weather Chinaman." These people are the inhabitants of the Chinese Province of Hunan, the boundary of which is 100 miles from the Bawdwin mines. They are all cultivators. After the rains are over and the crops are gathered at home they start for the border and cross into Burma to find work in road building, grading, or any kind where they can take small contracts and make more than standard wages. The public works department of the Provincial Government and the operations of the Burma Corporation take the greater number. For the latter they do all the outside work which cannot be done in the rains, such as road building, grading, foundation digging, but most especially forest felling and hand sawing. Some of them come as far as 400 miles, and are on the road at times for six weeks. They will work hard during their stay, taking mostly small contracts on a co-operative basis through a "gaung," or head man of their own choosing. They frequently work long hours, especially during moonlight. In the forest and outlying work no housing is available. Fortunately, during this season the weather leaves nothing to be desired for outside operations. The coolies build themselves "nests" near their work. These are merely wind-breaks of boughs laid up against a convenient tree or stake driven in the ground. Beginning in late February, and ending about the middle of March, they are gone. As well try to stop the migration of the swallow in the autumn. To get a job or a good contract in November or December, the coolie might promise to remain forever, or as long as he is wanted. On the first hot day of spring he forgets his promise, and when the vernal equinox arrives the "cold-weather Chinaman" has departed. He takes his wages in silver rupees, as these only have a value in his home.

Crimes of violence are almost unknown. I do not mean that they are unknown in Burma, because "Dakoity," or organized banditry, is not uncommon in Burma; but a case of homicide or felonious wounding is almost unheard of around the plants of the corporation. Thievery and petty pilfering are common.

The Chinaman has many good qualities which commend themselves to one in charge of large undertakings. He will make a contract, and keep it whether profitable or not. He is industrious, frugal, and independent.

Much stress has been laid in recent times on the necessity of a permanent labor force for the company. This cannot be obtained without difficulty where labor must be imported. Perhaps the shortage in the labor supply has been overemphasized at times to divert attention from failure to provide adequate facilities in other directions. Thus the reason for inability to increase output was ascribed to labor shortage, when the mine was producing and the smelter was reducing every pound of ore that the railway could transport with the facilities at hand.

Kachin women

Under the most favorable conditions in Burma no new equipment can be provided within less than a year. This applies almost as much to labor as to the mechanical equipment of the railway and smelter. A temporary shortage of labor hampers operations during the monsoon period, but this can always be minimized by a surplus of equipment and facilities. Continuity of policy and promptness of decision are essential to successful operation.

Mining Engineers Favor Metric System

Recently the Mining and Metallurgical Society sent out a questionnaire to representative mining engineers to find out their attitude on the introduction of the metric system. A total of 138 of these questionnaires were answered. The first question asked was, "Do you believe that the general introduction of the metric system of weights and measures in place of the English system would constitute an advance in efficiency?" Of the replies, 91 were positively affirmative, 19 conditionally affirmative, 6 doubtful, and 22 negative. Further, it was the opinion of those consulted that the change should not be left entirely to individual initiative; that it should be assisted by resolutions and committee work of technical and business societies; and that the Federal Government should take steps to establish the system.

The Control of the Silver Market

Forces at Work and the Influence of Government Activities Upon Demand for the Metal—A Silver Exchange Difficult to Establish—Room for Increased Industrial Consumption

By Felix Edgar Wormser
Assistant Editor

SILVER MINERS in the United States have occasionally expressed dissatisfaction over the present method by which the world price of silver is established. They reason, if I sense their attitude correctly, that inasmuch as the United States, Mexico, and other countries produce, with the aid of American capital, by far the lion's share of silver, they should have more of a voice in setting the daily price of the white metal. They are apprehensive of the close connection between financial London and the Government of India, with the possible influence this liaison can have over the demand of the world's most important silver-consuming country, and refer one to the strong grip of London banks upon Far Eastern exchange transactions. The completion of the repurchases of silver under the provisions of the Pittman Act—expected next July—and the probable participation then of the American silver producer in the world market after a lapse of over three and one-quarter years are good reasons for inquiring into the charges that have been made, to reflect upon the system of buying and selling silver, and what changes, if any, in method would be likely to increase prices to the producer.

It is common knowledge that four bullion brokers in London, of honorable and long business record, "fix" a price for silver every working day of the year (at 1:45 p.m.) and that this price is extremely important in the world market. The impression often prevails that other silver centers, such as New York, San Francisco, Bombay, and Hongkong, make quotations which are merely translations of the London quotation into the local currency, making allowance for differences in exchange and the cost of shipping silver from place to place. However, the action of the various markets is not so simple. It often happens that the local demand or pressure to sell the metal in one of the world's markets may be strong enough to advance or depress the current price there; consequently, the normal relation between that particular center and others may be altered. This condition may obtain until the circumstances causing it are removed. But it is true that the silver markets all over the world must take into consideration the value of the metal in other parts as well as the local demand. In like manner the price of silver in London, which means the value established by the bullion brokers, must be an appraisal of not only British but also universal market conditions. Otherwise the price determined by these agents would be artificial, and, as such, might subject them to heavy losses, for the quotations made form a basis upon which silver is actually bought and sold in London. If the price established be too low, supplies of silver to meet a requisite demand would not be forthcoming, and the artificial condition would be aggravated; when made too high, large supplies would appear.

As business is carried on in London five hours ahead of New York, the American silver producer or bullion broker has the advantage of having placed at his disposal the result, expressed in quotations, of a keen prior survey of the silver market. Under these circumstances it is hardly to be expected that the New York quotations would vary widely from the London figures, provided, of course that the London analysis of market conditions, as reflected in the established prices, is reasonable. The picture that is sometimes painted of London driving the other world silver markets arbitrarily to her will is contrary to economic precepts. All the major silver markets are mutually susceptible to each other and governed by economic laws.

At first sight the volume of American silver production seems impressive, but if we investigate the part played in the total world production the rôle does not appear so formidable and loses some of its force when used as an argument for American control of the market. In the first place, although the United States and Mexico produce about 70 per cent of the world's silver production, American capital controls only 52 per cent of the supply, whereas British capital controls 33 per cent[1]. This indicates that a good proportion of Britishers is also interested in the silver market. Hence the blanket indictment occasionally made that it is to the benefit of the British Empire to have a low price for silver requires some qualification. Many mining companies, predominantly British in character, operating in Australia, South America, Canada and other countries, would hardly subscribe to any concerted effort of their countrymen to hold down, if they could, the price of silver by artificial means. It is true, of course, that the needs of the colonial possessions of the commonwealth, particularly those of India, the Straits Settlements, Hongkong, and African colonies, may have a more pressing claim on the policy of the government, as they are more likely to cause serious political disturbance, but the interests of the numerous silver producers cannot be totally disregarded.

The thought lurks in the mind of some observers that the London price of silver is an arbitrary one, dictatorial in the sense that the world's markets must follow it slavishly. This is hardly in line with sound business reasoning. No country or group of men can set an artificial price for a commodity, unless they have a monopoly, and expect that the world will accept the price. Silver is a commodity widely produced and consumed throughout the world. No four bullion brokers, or any gathering of Americans, for that matter, can hope to sit back, even with powerful financial support, and among themselves decide what price the world shall pay for silver, regardless of circumstances. World trade conditions—not the dictum of a few people—govern the price of silver and are reflected in its value.

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[1] "Political and Commercial Geology": J. E. Spurr. See charts facing p. 540. Although these estimates were made for 1913 production, I do not believe the ratio has changed greatly.

The influence that governments can exert upon market conditions rather than the London method of quoting silver prices is partly responsible for the troubles of the silver producer. The London market is an effect, not a cause. It is obvious that the forces of supply and demand act upon silver as readily as they do upon other metals. If a merchant, speculator, or miner feels that the price of silver is too low, he can withhold his metal from the market until a more favorable price appears. Consumers can use the pressure of their buying power to oppose this tendency—that is, they can refrain from buying when the price is too high. Between these two forces some price will assure an adequate supply to meet a certain demand. It is that price which the London bullion brokers attempt to set. They are aided in this by the comprehensive machinery of the market which offers every opportunity for the speculator to carry out his operations and gives breadth to it. Both spot and future quotations are made. "Puts," "calls," and "straddles" are also bought and sold, and trading is as broad and open as in any of the other great commodity markets of the world in wool, grain, and cotton.

Even if we grant that the London method of quoting the silver market is narrow and wrong, what method would we substitute and how can it be broken? The principal plan so far advanced has to do with the formation of a Silver Export Association, through which it is hoped that a more solid front can be presented in disposing of the metal and a better price obtained for it—otherwise it would have little justification for existence. If, say, 85 per cent of the American and Mexican silver production were represented in the organization, it is conceivable that it could influence prices, but only by keeping silver from the market. The province of an export association is, however, orderly marketing, to counteract any concerted attempt by consumers to exploit the producers, and the organization would be acting out of its proper sphere when speculating. In the long run I do not think much will be gained by such tactics. More than one attempt has been made to corner the silver supply, but none, so far as I know, has ever been successful. Silver, unlike copper, lead, zinc, wheat, wool, cotton, grain and other raw materials, is neither completely destroyed in using or changed into some form from which it cannot be quickly recovered. Current production of silver must compete with supplies that have been on the market for years, and is not so important as the current production of copper and wheat, for example, is to those particular markets. Enormous quantities of silver are hoarded in the hinterland of India and China and in Africa. Much of it is locked up in the form of coin, ornaments, and bullion, but how securely no one knows.

The Far East Influential in Demand for the Metal

In silver, especially, it is the consumer who sets the market. India, China, and the various governments of the world using the metal in coinage are the chief buyers, and they use it mainly as currency, whether in the shape of bullion, silver dollars, Indian rupees, Chinese sycee, or other forms. It is most esteemed by those countries having a low wealth per capita—India and China—where the inhabitants, through long association, have grown accustomed to silver and entertain a high regard for it. The natives of India love to bedeck their womenfolk with silver ornaments. It has long been an ideal medium for concentrating their wealth to permit quick and convenient movement from village to village. They obtain silver in payment for the agricultural products which they sell in the world markets—jute, rice, wheat, and other Asiatic produce. When India and China have a heavy export trade a strong demand for silver arises and the price of silver has a tendency to advance. Encouragement of the export trade of India and China is beneficial to the silver miner. It is assuredly not to the interest of the great British Empire to discourage the foreign trade of the Far Eastern countries.

The trouble has not been with the condition of export trade in Asia, which is difficult to influence, being largely dependent on climatic conditions, but the attitude of most of the European governments in debasing their silver coinage and even doing away with it entirely. They have done this generally of their own volition, although extraordinary currency depreciation made it impossible to maintain silver in circulation with depreciating paper money and sent it to the melting pot. Staid and conservative England, for the first time since the reign of Queen Elizabeth, reduced the fineness of its silver currency from 925 to 500 fine. Canadian silver coins have been decreased in fineness from 900 to 800; Straits dollars from 900 to 550; Netherlands and the Dutch Indies coins froum 945 to 720; Honduras and San Salvador units from 900 to 500; Peru to 500 recently. In Austria, Belgium, France, Germany, Italy, Poland, Bulgaria, Russia and many other European countries silver has disappeared completely from circulation, probably into the hoards of the inhabitants of each of these lands, or in the government melting pot to be recoined or sold. It is remarkable that the silver market has not shown the effect of this European silver debauch more than it has. Incidentally, the debasement of silver coinage gives the debasing country an enormous seignorage, which in these days of financial stringency is most welcome.

One of the most striking methods of currency debasement, if it can be called that, and at the same time an especially important one, has not been given much attention by silver authorities, probably because of the subtleness and indirectness of the charge. It is the reorganization of India's currency which took place three years ago. From 1893 to 1920 the silver rupee of India was worth 32.55c. in American money, or Rs. 15 to the pound sterling. In 1920 this rate was officially changed to Rs. 10 to the pound gold for the purpose of stabilizing Indian Exchange. In other words, the rupee was given a face value of 48.7c. Weight and fineness of the coin were unchanged. As a result of this official action the same amount of silver that served the older rupee face value was made to do for the newer one. There is little distinction between this method of currency reorganization and the more spectacular one of decreasing the silver bullion content of a coin. However, its very indirectness has caused the matter to be overlooked generally. Yet India, besides making a great seignorage under the new arrangement also decreases the actual amount of new silver required for the coinage and trade of the country. The government has been severely criticised by its citizens for the step which it took. When the American silver miner charges that the British Government is deliberately influencing the use of silver, one of the strongest bits of evidence he can muster in substantiation is the debasement of Great Britain's currency and the remodeling of India's. Both

of these events have had and will have an important effect on the market for silver, although India's silver reserve is now so high that additional purchases of the metal would not be necessary anyway. It is unfair, however, to maintain that the primary object of the British Government in its actions was solely to depress the price of silver. The great irregularities in commodity price movements, phenomenally high prices for silver, and the worldwide disorganization of foreign exchange must be held in large measure responsible for the treatment silver has received in European and other currency systems, but, unfortunately, silver has been the "goat."

The Field of an Export Association

How can the situation be improved? A Silver Export Association would have as its primary function to facilitate the sale of silver abroad. Should it attempt any other, such as speculating with silver, withholding the metal from orderly marketing, the association would probably discover some of its more important members frowning upon that policy, besides having trouble with its bankers. Thus, custom smelters who depend for their profits upon the smelting and treatment of ores cannot afford to speculate with the metals they buy. Their sales principle is governed by the rule that the sales of metals should equal in volume and value, so far as is possible, the intake of metals in ores and concentrates. Hence it is hardly to be expected that they would look with favor upon any speculative scheme for influencing the price of silver, through an export association.

A suggestion has been made that a holding corporation should be formed whose avowed object would be the marketing of silver, so as to avoid heavy fluctuations, a purpose to be attained by judicious handling of the American production in the world market. It is also hoped to obtain a better price for silver through this arrangement, but besides requiring a heavy capital expenditure and strong financial backing, it is extremely doubtful if such an organization could achieve more than a stabilization of prices. For one thing, interest charges accumulate rapidly on idle stocks of such a valuable commodity as silver, and these charges must be deducted from the price received ultimately to obtain the net price to the producer. If stocks are accumulated they will have to be sold sooner or later and would have an effect upon market prices at that time or before, as the mere knowledge of the existence of large undigested stocks would be sufficient to depress the market. Will the banks provide the funds required for speculative purposes? Silver is a particularly difficult metal to deal with; its future is more uncertain than that of other common ones.

The most effective protest which producers of any commodity can make when prices are too low is to decrease production. Such a protest by silver producers is apt to be feeble, for silver is mainly a byproduct metal dependent upon the output of copper and lead, and is recovered, willy-nilly, by the base-metal mining companies.

Some market specialists are of the opinion that the formation of a silver exchange in New York is a solution to the problem of transferring the leadership in the silver market from London to New York. This view is not substantiated when considered in the light of experience. A number of years ago silver was traded on the New York Stock Exchange, which arranged with a safe deposit company for the receiving of the silver bullion, 1,000 fine, warehouse certificates being issued against it. These certificates were recognized as good delivery on the Stock Exchange, and a special silver post was created for the purpose of trading in the metal; but interest soon died in the venture, and the experience was a failure.

The establishment of an exchange in New York that shall be more than a name is involved in the ability of New York to equal London in the importance of its currency in world trade. Until India, China, and other Oriental countries use dollars as freely as they use the pound sterling in the conduct of their business with the outside world it would be difficult to establish a virile silver exchange in the United States. One of the reasons why London is so powerful in many of the world's most important commodity markets is the wide scope of the markets there. Every facility is offered the speculator to transact his business on the leading exchanges. Speculation is encouraged, as it is believed to be beneficial to the market, having a useful function to perform in preventing violent fluctuations in prices and enabling manufacturers to "hedge" their purchases and sales. In the United States, to judge from laws that have been passed and the statements of many of our lawmakers, speculation is condemned and curbed. It is but natural that the Oriental, with his fondness for speculation, should be attracted to those markets offering the widest scope for its practice. Until we are ready to emulate London or go to her one better, I do not see how we can hope to equal her importance in the world's silver market.

United States Banks in Asiatic Lands

The growing importance of American banking in the Far East and consequently in the silver market is emphasized by the increased amounts of silver bullion that have been moving directly to Asia instead of being routed through London. The following table, in which the movements of silver for comparative purposes have been converted from dollars into ounces, is a striking illustration of the trend.

Shipments of Silver from the United States *(a)*

In Ounces

Year	To London	To Asia	To Other Countries	Total
1912	82,876,000	18,406,000	12,837,000	114,119,000
1913	67,437,000	20,733,000	12,759,000	100,929,0
1921	7,521,000	24,961,000	3,501,000	35,98?,0
1922 *(b)*	16,280,000	66,497,000	10,000	82,787,000

Shipments of Silver from London *(a)*

Year	To India	To China	Total
1912	93,832,000	15,045,000	108,877,000
1913	78,041,000	5,999,000	84,040,000
1921	48,730,000	26,600,000	75,330,000
1922 *(b)*	44,747,000	21,788,000	66,536,000

(a) From reports of Director of the Mint. *(b)* Estimated.

Before the war shipments of silver to London from the United States, Mexico, and Canada were the rule rather than the exception. In fact, 72 per cent and 67 per cent of our silver exports were sent to London in 1912 and 1913, respectively, but in 1921 and 1922 only about 20 per cent were sent via London, the bulk going directly to Asia. This state of affairs is echoed in the table showing the shipment of silver from London to the Orient. Despite the release of large quantities of metal by silver coinage debasement in England and on the Continent, the exports of silver from London to India and China in 1922 were smaller than those of the United States. This speaks well for the activities of

some of the American banks, which have become greatly interested in foreign trade, have enlarged their sphere to include more of Asia, and are doing their best to improve the facilities at the disposal of the American silver producer in transacting his business directly with the Far Eastern consumers. London seems to be losing its grip as the silver clearing house of the world, but it is difficult to say whether this is a permanent or transient condition.

Our policy seems to be isolation not only politically but also financially—a policy for which silver is paying the penalty. We decline, rightly or wrongly, to mix in the reparations question, yet I cannot think of another matter so vital to the American silver miner as that. Were the reparations problem settled, European currencies would be nearer stabilization; silver would reappear in circulation; trade and business conditions would improve between East and West, and the silver question would not be so acute.

PUBLICITY FOR THE HIGH QUALITIES OF SILVER

It is highly desirable to increase and widen the uses of silver in the arts. Industrial consumption of silver falls far behind its use in currency, and it is hard to believe that the demand for the metal in manufactures cannot be increased. Silver has suffered from substitution by other metals even more than copper and zinc. Its color is easy to imitate cheaply, and some of the substitutes go so far as to ape its name with designations such as silvore, silvel, and others. Why not popularize silver articles and ornaments, calling attention to their permanence, usefulness and beauty? Results as pronounced as those of the copper, brass and zinc companies may not be obtained, but some tangible benefits should accrue. The moving-picture industry is using a considerable quantity of silver. I am informed by the leading film manufacturer that he uses three tons of bullion weekly, or one-twelfth the domestic production.

The whole question of bettering the position of the American silver-mining industry, controlling the silver market, and relevant matters, is inextricably bound with our attitude toward foreign trade. Soon after the armistice our prospects of assuming a prominent place in international commerce were at their peak, but since then they have gradually declined. Grandiose schemes for capturing and retaining the world's major markets were conceived through the aid of powerful foreign trade financing corporations, but they have gone by the board. An improvement in our position does not appear promising, especially in view of the present temper of the American people with regard to foreign affairs. Silver has deeply felt the situation, and until we are ready to pursue a different course and to take a broader view of foreign trade problems I am afraid that the American silver market will have to be content with being the lamb and not Mary.

Rare-Metal Production in Ontario

The Provincial Minister of Mines reports the production of rare metals in Ontario during 1922 to include platinum, 176.18 oz.; palladium, 341.44 oz.; and 124.44 oz. of a group including rhodium, ruthenium, osmium, and iridium. Rhodium formed by far the larger percentage of this group. The average price for platinum advanced from $75.03 in 1921 to $97.61 in 1922. Palladium and rhodium group metals were valued at $45 per ounce for the purpose of this report.

Liquid-Air Explosives in Europe

Translated from an article by G. Joubert in *La Technique Moderne*

Blasting with liquid oxygen possesses the following advantages: power, economy, absolute safety, absence of danger from misfires, and absence of a poisonous gas that is injurious to the health of miners and other employees. Two disadvantages alone remain to be surmounted: Too short life of the cartridges, arising from evaporation; and the necessity of boring the holes 30 mm. (1.18 in.), 35 mm. (1.38 in.), and preferably 40 mm. (1.57 in.) and more, which requires a good deal of extra work when one is drilling hard ground, such as certain granites or gneisses.

Despite the unimportant drawbacks mentioned, it is particularly interesting to note that for more than one-half of the iron ore broken down in Lorraine, Weber cartridges and liquid oxygen are used, and if, to those of the Lorraine basin, are added the mines of Joeuf, d'Errouville, and of Mancieulles (though situated in Meurthe-et-Moselle), which use the same blasting agent, one arrives at the imposing figure that more than 60 per cent of the ore is being mined with liquid oxygen and less than 40 per cent with black powder.

It is interesting to mention also that the miners are pleased with the use of the new explosive; the work is quicker, the product better, and the daily wages of the miners are higher than when black powder was used. Finally, the complete absence of poisonous gases seems to be particularly agreeable to them. The miners themselves are so well used to the new explosive that if, for one reason or another, the supply of oxygen fails, they prefer to wait rather than use another explosive.

On the subject of the increase in ore broken per day, there has been obtained from MM. de Wendel et Cie, the official figures of their operations for a long period (close to fifteen years). Before the introduction of mechanical drilling (1908), the mean production was 5.845 metric tons per day of ten hours for one miner and his assistant. The application of mechanical drilling increased the production to 7.066 metric tons per ten-hour day, with black powder. By the use of Weber cartridges and liquid oxygen there is obtained at present, in the mines of Hayange, an average production per operative miner, of 9.323 metric tons, say 2,257 kg., or 32 per cent more than with powder, although the work-day is only eight hours instead of ten as of old.

Plating With Chromium

After a brief historical survey of the difficulties encountered in depositing chromium electrolytically, E. Liebreich points out, in the *Zeitschrift für Metallkunde* (Vol. 14, p. 367, abstracted in *Chemistry and Industry*), that good coherent deposits can be obtained on iron, copper, brass, nickel, and the like by the use of an electrolyte containing hexavalent and trivalent chromium. According to the conditions, the deposit may be obtained as an even mirror-like coating or in the matt condition; the former is very thin, but the latter can be built up to several millimeters in thickness. The rate of deposition is about 0.16 g. per ampere-hour for the matt surface and about 0.03 g. per ampere-hour for the bright surface. Articles coated with chromium are resistant to organic acids, alkalies, iodine, and mercuric chloride; they are attacked by hydrochloric acid and by hot sulphuric acid, but not by nitric acid of any strength.

Advantages of Basic-Electric-Furnace Iron for Castings to Resist Abrasion

Common White Iron Has Many Deficiencies, Inherent in the Process of Manufacture—So-called Synthetic Iron, Made in the Electric Furnace, Much More Satisfactory for Crusher Jaws, Ball-mill Liners, Roll Shells, and Other Parts

By Larry J. Barton
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ON LOOKING through the different mining and metallurgical periodicals one often sees an advertisement about like this: "Mr. Mine or Mill Owner: For grinding or abrasive purposes our castings excel. Use ours and become satisfied." The ad. usually follows, giving a description of the castings, and the claims made are generally of interest to a prospective purchaser. A trial is made of the castings, and it is often found that they are no better—in fact, they are often even worse—than those previously used. To users of castings for grinding and abrasive work, this article should afford an insight into what makes a fine casting and why. Most mining men know what is desired in a casting, but do not know exactly how to specify their needs. They leave this point to the foundry, which makes their product, sends it out, and then forgets about it. I have investigated large tonnages of abrasive castings for many different uses, and through experience have found what I consider to be the best metal for this use. The following is written from practical experience, and it is hoped will prove of benefit.

My first experiences with grinding problems were when stones, rubbed against one another, were used. This process was extensively employed, and even up to now pebbles are used in some ball-mill installations. Conditions changed, and iron castings began to be used. Greater experience along grinding lines developed "white iron," which has been extensively used for this class of work. Of course, certain classes of steel, such as chrome and manganese, enter into competition, but this paper is intended strictly to cover white, hard irons. To best show the failings of white iron, as it has been made, it would be well briefly to sketch its manufacture.

White Iron Made in the Cupola

In this process a shaft furnace is used. The bottom, or hearth, is made of rammed sand, which is dried out with a wood fire. Coke is piled on this, and when incandescent the air blast is started, the metal is charged, and melting begins. As the air blows up and through this coke it supports the combustion, giving an intense heat. This causes the iron to melt and trickle down through the bed of coke onto the hearth. When sufficient has accumulated to fill a ladle, the cupola is tapped and the metal poured. The process is then repeated until all the castings on the floor are poured. This method can never produce a quality metal, for the following reasons:

1. *Oxidation*—Iron passing through an air blast when in the molten condition will invariably pick up and dissolve oxygen, forming oxides of iron or manganese in the metal. There is no possible way to free the iron from these inclusions, and the casting is poured. The result is a casting containing gas pockets, blowholes, and internal cavities.

2. *High Sulphur*—Nearly all of the present supply of coke is high in sulphur, and as the metal trickles through, the percentage of this element in the iron is raised. When poured, it manifests itself in dirty spots in the casting, weak places, internal cracks, and general brittleness.

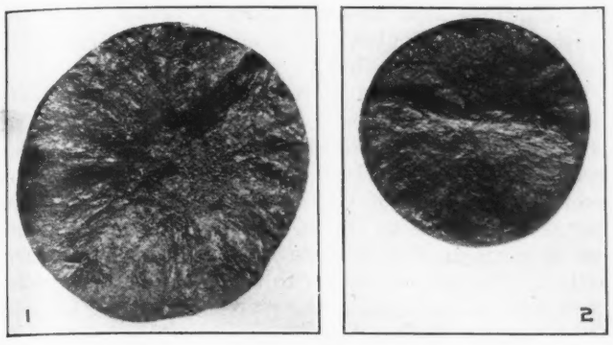
3. *High Phosphorus*—To make the iron run properly, high phosphorus charges are used. This element is well known as the greatest cause of brittleness in either iron or steel. The result is a casting which is inherently brittle.

4. *Temperature Control*—In the cupola this is impossible, and consequently the iron is often poured cold, resulting in a casting containing internal seams or cold shuts. Dirt, coke, or other non-metallic impurities are often entrapped, later to be found by the purchaser in a failed casting.

Any user of white-iron castings will readily admit often having found some of the above-noted conditions at one time or other. The question here arises, "If white iron as made is so unsatisfactory, why have not the manufacturers turned to better methods of production?" This can be answered in several ways. To make better iron costs slightly more, and many are afraid to take the initial step. Then, too, the buyer cannot see where the added price should be paid for castings as yet unproved. I will later further explain both of these points.

I have shown why cupola iron cannot be made of high quality. The next consideration is iron made in the acid electric furnace. This process eliminates all of the above-named objectionable points except those relative to sulphur, as there is no refining done in this furnace. As this is midway between cupola iron and high-quality iron I will not expand on this, but will proceed to a discussion of the highest quality white iron. This is made in the basic electric furnace, using steel scrap as the base metal. It is also known as synthetic iron. To show the differences between this and cupola iron, consider the same four topics discussed above:

1. *Oxidation*—In the basic-electric-furnace process the metal is melted upon a well-burned hearth of magnesite by means of the electric arc. It is then covered with a heavy lime slag, together with a small amount of finely ground coke, and is at no time exposed to air. The coke present in an incandescent condition effectually prevents any stray air from touching the metal. The slag is thus kept strongly reducing, and not only is oxygen prevented from entering the metal, but any present in the steel, as rust, is thoroughly removed. This accounts for the fact that castings made by this process are solid.



Photographs of fractures. Fig. 1, cupola iron. Fig. 2, electric-furnace iron.

2. *High Sulphur*—The metal is always on the magnesite hearth and covered with a lime slag. Under reducing conditions this lime slag will quickly free the metal of sulphur, by combining with it chemically. The longer the bath is held, the lower the sulphur, and often heats are poured containing less than 0.01 per cent of this element.

3. *High Phosphorus*—As steel scrap containing approximately 0.04 per cent phosphorus is used, this element will remain at this figure, instead of about 0.30 to 0.50 per cent as in cupola irons. Consequently, the iron made in this manner has great toughness compared with ordinary white irons.

4. *Temperature Control*—The metal is always under the arc until ready to pour, and the longer it is held the better it gets. The iron can therefore be held until all conditions are right before pouring. Not only does this improve the temperature control, but greater regularity of the iron can be attained, as it can be held in the furnace until chemically correct. Iron cannot be held in the cupola under any conditions, and if not right must be poured regardless of its chemical analysis.

This comparison shows the superiority of basic-electric-furnace iron above that made in the cupola. Conclusions may be summarized as follows:

1. Castings thus made will be free of blowholes, internal shrinks, or gas pockets.
2. Castings will be free of dirt or other non-metallic inclusions.
3. There will be no segregation of sulphur or phosphorus, tending toward brittle castings.
4. The iron will run clean, eliminating any seams or cold shuts, and will always be of the correct chemical analysis.

Method of Manufacture

The furnace is charged with steel scrap, together with sufficient coke to raise the carbon and enough lime to form a slag. The current is turned on and the steel melted. As it melts it combines with the carbon of the coke, which gradually changes the metal from steel to iron. As soon as melted, small test blocks are poured from the furnace and broken. The appearance of this fracture is the test of the metal. If the carbon is not determined to be high enough, the bath is boiled with green poles and further tests are taken. When the appearance of the test is satisfactory, the attention of the melter is turned to the slag. This is worked until a test taken from the furnace powders in the air, giving off a strong odor of acetylene when immersed in water. This shows that conditions tending toward the elimination of gases and sulphur are right. The necessary alloys are then added and a final test is taken. This is sent to the chemist, and upon his O.K., the heat is poured.

Fig. 1 shows a fracture of common white iron as made in the cupola. Note the rather porous center, together with the varied appearance of the fracture, and that this irregular appearance is due to different hardnesses. Note, also, the rather open grain, with evident planes of weakness. Fig. 2 shows a similar fracture of electric-furnace iron. Note the close, dense fracture, with its apparent toughness, together with the regularity of grain size. The analyses of the two irons were as follows:

	—Carbon—						
	Combined	Graphitic	*Mn	Si	P	S	Cr
Cupola.....	3.20	0.18	0.58	0.55	0.34	0.105	0
Electric furnace	3.02	0	0.33	0.53	0.06	0.032	0.60

Synthetic iron so made is recommended for any use where common cupola white iron is now in service. This covers particularly conditions where abrasive resistance is desired and where there is no appreciable impact. This iron can be used for impact service, when thoroughly supported or backed up by steel. It closely resembles white iron in several respects:

1. Its hardness is slightly above that of white iron.
2. Its strict wear-resisting qualities are much superior.
3. Its brittleness is less than that of white iron but higher than that of gray iron.

In actual service, covering many different lines, synthetic iron has proved to have a much greater life than white iron. This is readily explained: Its closeness of grain is such that it will wear longer; the addition of alloys gives it superior hardness; and the elimination of defects, sulphur, and phosphorus makes a much tougher iron.

Ball-mill liners require an iron with maximum abrasive resistance qualities, together with a medium amount of impact resistance. Electric-furnace iron has found extensive use for this class of work, and from actual operating tests will greatly outwear anything on the market, whether white iron or chrome or manganese steel. During my experimental work, several alloys were tried for this special purpose, and it was found that an iron with a small amount of chromium proved to give the best results. This metal had an exceedingly close and dense grain of a dull, gray appearance. It was very tough, and could not be cut with a file. This iron was placed into service several months ago in several ball-mill installations, and from statements of the operators it is going to give at least two to three times the service of white iron, which was formerly used. There has been no cracking, no defective castings have appeared, and the wear is hardly apparent. What slight wear has occurred has been unusually regular, showing a freedom from the soft spots that are so common to other metals.

Adaptability to Crusher Jaws

One manufacturer using castings for crusher jaws and rolls was having trouble with white iron. On one set of crusher jaws there were four pieces. His difficulty was that, owing to different grades of hardness, one jaw would wear out much faster than the others, requiring constant shutdowns for renewals. A new set was placed in operation consisting of three of ordinary white iron and one of electric-furnace alloy. The ordinary life of a set of jaws was about twenty days. At

the end of this time it was found that two of the white-iron jaws had worn so that they required replacing, and one was nearly worn out, but the electric-iron jaw was still in excellent condition. Three new jaws of electric iron were placed in operation, and at the end of over thirty days all, including the first, were in good condition. The duty here was strict abrasion, the work being that of crushing old brick for use as roofing material.

Comparative Tests Favor Electric-Furnace Product

In the same plant was a set of large cylindrical rolls into which the crushed brick from the jaw crushers was dropped. White iron had not proved suitable for the rolls, as there was a tendency to crack under the stress of repeated vibration and slight continual impact. Gray iron was tried, but wore out so quickly that its use was prohibitive. The manufacturer had decided to try manganese steel, when his attention was attracted to electric iron. He was rather afraid to test it after his experiences with white iron from the cupola, but finally consented to place one roll in operation, against a hard gray-iron one in the next mill. In ten days the gray roll was out of service, though there was hardly a scratch on the new alloy. After trying three gray rolls, he made his last replacement with synthetic iron. That was several months ago, and so far his crushing plant is in constant operation.

In a similar industry trouble was being experienced with the tips used in sizing gravel. These tips revolve among the rock, gradually forcing it to the sizing screens, and incidentally doing a fair amount of crushing in this operation. White iron had been used, but proved a failure. Gray iron was too soft, and finally chilled gray iron had been used with a soft back and a white surface. This worked well until wear had penetrated the hard skin, when the piece would rapidly fail. Electric-iron tips were tried, and these have cut the amount of castings required in half.

In many industries where crushing is done by rolls there are a series of plows, or scrapers, which follow the roll and scrape any adhering material loose as the roll revolves. This is common in such operations as crushing lime, mixing mortar, and grinding different chemicals. The wear here is strictly abrasion, which rapidly wears away the point of the tool. For this purpose electric-furnace iron has shown excellent results, both from the standpoint of abrasive resistance and from its acid- and alkali-resisting qualities. Further experiments are now being conducted on this phase of service.

I wish to emphasize the fact that I am not connected with any manufacturer of castings in any manner whatever, but am merely offering the above information in an endeavor to overcome many present-day troubles.

Specifications to Cover the Desired Material

Proper specifications are rather hard to lay down, as almost every job will require a slightly different specification. In a general way the above-described castings can be specified as follows:

1. Castings shall be true to pattern and finished in a workmanlike manner.

2. Castings shall be made by the basic electric process.

3. Castings shall contain a maximum of 0.04 per cent sulphur and 0.10 per cent phosphorus.

4. Castings shall be held under a carbide slag for at least thirty minutes, and shall not be poured until test shows absolute solidity.

If these are followed there is no process, other than the one described, which can satisfy them, and the purchaser is sure of obtaining what he desires. These specifications can be elaborated for a special use. In specifying, it will not be enough simply to state that they shall be made by the basic process, for poor metal can be made in this furnace as well as by any other method. The process is new to the trade, and naturally many will be skeptical of my statements, especially if called upon to pay slightly higher prices for castings. As time goes on and this metal becomes better known I believe that basic-electric-furnace iron will be used for all classes of abrasive work throughout the mining and milling industry.

Mining in Siam

Tin and wolfram are the only metallic ores which figure in Siam's exports. Gold mining has been attempted, and rich deposits of lead and silver have been reported in north Siam, but the inaccessibility of the mining land has made the development slow. The sapphires which are named in the customs report for 1920-21 are mined by Shans at Pai-lin, French Indo-China, formerly Siamese territory, and are exported through Bangkok.

Modern tin mines are entirely in the hands of foreigners. Australian capital controls most of the tin workings, although some English and a small amount of French and Danish money is invested in tin. Chinese work numerous open-pit mines by hand, but their operations are so irregular (their mines vary from two women panning ore in a creek to an organization employing a hundred coolies) that it is difficult to keep track of them, says a recent article in *The Far Eastern Review*.

The Siam Coal Mining Co., Ltd., which is soon to begin operations at Bandon, in southern Siam, is the first all-Siamese mining company to undertake large-scale workings.

Practically all tin ore mined in Siam is smelted at Penang.

Tin is produced in four provinces in Siam—viz., Puket, Surashtra, Nakon Sri, and Patani. Puket has always produced more than all the other provinces combined. For the year ending March 31, 1921, the figures were as follows: Puket, 87,605 piculs (133⅓ lb.); Nakon Sri, 9,417 piculs; Patani, 6,186 piculs; Surashtra, 974 piculs. Nakon Sri also produced 1,936 piculs of wolfram ore, the average price of which amounted to $32.92.

The figures for the output of the last five years follow:

Year Ended March 31	Dredging, Piculs	Tin Obtained From Other Sources, Piculs	Total Piculs	Average Price per Picul, Straits Dollars
1917	47,298	99,961	147,259	89.00
1918	51,343	102,439	153,782	22.00
1919	52,124	96,301	148,425	147.84
1920	74,993	68,513	143,506	148.30
1921	59,013	45,170	104,183	129.95

Tin Production by Provinces in 1922

	April	May		Average Price April	May
Patani	681	670	Tin	$76.90	$76.47
Nakon Sri	918	1,084	Wolfram	11.33	14.20
Puket	6,560	6,593			
Piculs	8,159	8,347			

The Philosophy of Wire Rope

A Reflection Upon Its Place in Modern Industries and the Problems Solved by the Manufacturer in Its Design and Use

By Henry M. Hall
General Superintendent, George C. Moon Co., Inc.

Henry M. Hall

WHAT is a wire rope? Is it merely a bunch of iron or steel wires, twisted together in a more or less casual manner, and expected to be magnificently indifferent to any and all use and abuse? Or is it a carefully selected and assembled collection of wires, scientifically spun into a fine tool, apparently simple, but in reality a most complex mechanism, wonderfully effective and efficient when properly used and cared for, but otherwise most wasteful and costly? How many rope users are aware of the hundreds of years of thought, effort, and development represented by the materials and construction of a fine wire rope, or realize that in 100 ft. of a rope one inch in diameter there is more bearing surface to be lubricated than in a 35,000-hp. twin tandem reversing rolling-mill engine?

There is no question that the manufacture of wire was one of the earliest forms of metal-working practiced by the ancients. The earliest wire was formed by hammering and filing narrow strips of metal, and was doubtless first used for jewelry and decorative work, as evidenced by the beautiful and interesting objects containing gold or bronze wires found in the remains of the cities of ancient Egyptian and Mediterranean civilizations.

The earliest known written reference to wire-drawing and the wire-drawing die is found in a Latin manuscript by the monk Theophilus, the exact period of which is unknown, but which was somewhere between 700 and 1000 A.D. Many quaint and interesting documents and records, some of them fascinatingly illustrated, have come down to us from the Medieval ages, descriptive of the art of wire-drawing. As early as 1270 A.D. wire-drawing had become such a developed and recognized craft as to warrant the promulgation by the City of Paris of a set of rules covering the conduct and control of wire-drawers.

The Modern vs. the Old

It is indeed a far cry from the crude wire mills of the Middle Ages, producing daily but a few pounds of wire in short lengths, to the huge mills of today, capable of a daily production of hundreds of tons of wire, of all kinds and for all purposes! And yet in those quaint wood cuts of the old-time wire mills can be plainly recognized the prototypes and ancestors of many of the appliances and ideas in use in the most up-to-date of modern mills.

Although specimens of ancient wire rope are known, like the fifteen-foot piece of a four-strand wire rope of bronze, dug up at Pompeii, the history of wire rope as we know it dates back only a hundred years, when it was used for the supporting ropes of the Geneva suspension bridge. These early ropes were of the "selvagee" type of construction—that is, composed of a series of parallel wires bound together by an external serving of finer wires, quite similar to the main cables of our modern suspension bridges. Soon, however, stranded wire ropes, analogous to hemp ropes, were introduced, and since that time the development and increasing use of wire ropes, begun in Germany and Great Britain, has been rapid.

Let us now consider briefly the requirements of a wire rope. In the first place, in active service it is subjected simultaneously to the stresses of tension, compression, torsion, and bending, together with the forces of frictional wear, or abrasion. A rope, therefore, must be designed and constructed to meet all of these stresses, whereas the usual structural or machine member has to take care of only one or two stresses. To meet all of these stresses, a rope must possess, each in a greater or lesser degree, the following mechanical qualities: strength, elasticity, resilience, hardness, toughness, endurance, and flexibility. Of course, it is impossible for any one rope to combine each one of these qualities in the highest degree, and it is therefore necessary to accentuate some two or three properties, which will be most needful in the particular service to be performed by the rope, even though we have to sacrifice the remaining ones to some extent.

The Control of Rope Characteristics

For any given rope the seven mechanical qualities noted are functions of certain variables, which are entirely under the control of the designer and manufacturer of the rope. These variables are: the quality and composition of the materials of which the rope is made; the method of drafting and heat treatment of the wires; the number, size, and arrangement of the wires and the strands composing the rope; the lay or pitch of the wires in the strands, and of the strands in the rope; and the lubrication of the wires and the strands. All these factors are susceptible of control and variation over a wide range, and the success or failure of a rope depends largely on the skillful and exact control and correct application of all these variables.

If main brute pulling strength is the chief requirement of a rope—as, for instance, a towing line—then we may use a rope composed of a relatively small number of rather large wires, specially hard drawn and heat treated so as to impart the utmost maximum of strength. The rope will be stiff, and the wires will be able to stand relatively little bending, yet the chief re-

quisite sought—great pulling power—will be obtained. Again, let us suppose that a soft, and exceedingly pliable rope is wanted, where strength and wearing qualities are of secondary importance—for example, the hand rope of an elevator. Then it will be composed of a large number of small wires, drawn from a soft, low-strength material, and so laid up as to produce the maximum of softness and flexibility. And so it goes. Great strength, resistance to wear, abrasion, or corrosion, elasticity, ability to stand up under repeated shocks or alternating stresses, softness and pliability—any one of these may be the chief desideratum, with the other properties, desirable as they all are, of necessity more or less completely sacrificed to that quality most needed, and which can be obtained by a certain definite rope construction.

In view of all this, it clearly behooves the rope user to study his requirements carefully, and to co-operate with the rope manufacturer, to the end that the proper rope shall be put to any given service. The experience of the rope maker in the manufacture of all kinds of rope, and his knowledge of the possibilities and limitations of the various kinds and construction of rope, are, or should be, of great value to the rope user.

But the story does not end here. After the right rope has been put in the right place, it must be given the right treatment. The finest possible rope, exactly fitted and adapted to a particular service, can soon be ruined and wasted by neglect and unintelligent handling. The sheaves and drums over which it works may be poorly designed, too small, or in defective condition; the rope may rub or chafe severely somewhere; it may be heavily overloaded, or run at too high a speed; it may be subjected to severe twisting or reverse bending; or it may be neglected and exposed to corrosion, and may not be given the proper and necessary lubrication. Any one of these and similar varieties of abuse may be sufficient to make all the difference between success and failure in the service and satisfaction given by a piece of rope, and it is decidedly to the advantage and benefit of the rope manufacturer to see that his customers realize this, and use and treat their ropes accordingly. Money and time spent by the manufacturer in educational and missionary work on the subjects mentioned above will return handsome dividends.

And, finally, there is the manufacturer of rope-using — oftentimes rope-consuming — devices. How many cranes, hoists, buckets, elevators, and all the multitude of appliances employing wire ropes are ever designed and built with particular attention to the efficiency and service to be furnished by the rope? True, in some instances it may be cheaper to use up two or three ropes a year in a given device than to so change its design and construction that the rope can have a useful life of twelve or eighteen months. But usually there is no good reason why the maker of the rope-using device and the rope maker cannot co-operate to their mutual advantage. They would both benefit thereby, and their customers would also most decidedly be the gainers. If the practical operator will figure the cost of two or more new ropes a year, together with the expense of taking off the old ropes and installing the new ones, as well as the cost of shutdowns and lost time, he will probably be amazed at the grand total. The difference between this figure and the total cost of a new rope say every eighteen months will probably pay a handsome return on the extra investment necessary to secure a device less destructive of the rope, and designed with some regard for its preservation and service. An automobile which is an extravagant consumer of oil and gasoline does not long remain popular, yet many rope-using appliances continue excessively wasteful of the rope—and the rope manufacturer gets all the blame!

Think for a moment what our present-day civilization would be without the wire rope! What about our supplies of solid, liquid, and gaseous fuels, and of lumber, stone and sand and other building materials, in the securing, transporting and utilizing of which huge quantities of wire rope are used? Where would our towering "sky scrapers" be without wire rope to make their erection possible, and to operate the hurrying elevators, to fill and empty them in almost the twinkling of an eye? What a serious handicap it would be for our ships and steamers if they had to return to the use of fibre ropes for their operations, loading, and unloading! These are some of the high lights, indicative of what the world of today owes to that young giant, scarcely a century old, Wire Rope.

The next time you are quietly and swiftly lifted to your office on the twentieth floor, or when you watch a slender wire rope dexterously swinging a huge girder high over the heads of the hurrying throngs below, let your thoughts dwell for a moment upon the sinews of spun steel that have made it all possible!

Troubles Due to Zinc in a Lead Blast Furnace

One of the chief troubles in the operation of a lead blast furnace treating a high zinc charge is the formation of crusts on the walls of the furnace. It has been found necessary at Great Falls, says R. B. Caples in *The Anode*, to shut down the furnace at least once in two weeks for a period of three or four hours and break down these crusts, otherwise they build out toward the center of the furnace, sometimes causing the charge to arch over in places, requiring poking down of the charge to get the furnace to smelt evenly. Crusts also tend to give uneven distribution of the charge, resulting in blowholes and a hot top, with excessive dust losses. These accretions are made up largely of zinc and lead sulphides and oxides, and require special charges before and after barring down, to be certain that they will be absorbed by the furnace slag when they reach the zone of fusion.

Hearth or crucible accretions often are sources of trouble and, unless they can be burned out with oxygen, the furnace eventually has to be shut down and completely dug out. These accretions are usually the result of one or more of three causes: (1) Too much copper on the charge and too little lead; (2) too much coke on the charge; (3) too little lead remaining in the crucible. To keep the crucible in good condition, the lead level must be kept as high as possible without getting above the slag tap hole, and there must be a good flow of lead through the crucible. Freshly reduced lead is hot and tends to keep crusts from forming in the crucible. If coke collecting in front of the slag tap hole is not completely blown out after slag is tapped, it tends to chill and form a crust with matte, speiss, and lead. If the lead level in the crucible gets below the tap hole, matte and speiss will chill on top of the lead, forming a hard crust.

Metallurgists of Note

FOREST RUTHERFORD

IF A COLLEGE is known by its graduates, McGill University, of Montreal, must have considerable pride, for it has trained a large number of men who have later achieved prominence not only in Canada but on this side of the line as well. Among these, Forest Rutherford stands high.

FOREST RUTHERFORD

Born in Montreal, March 24, 1871, it was perhaps natural that he should attend McGill, although, in those days, that city did not exclusively possess the attractions that now cause the nightly train from New York northward to run in several sections. Mining, with Mr. Rutherford, was an acquired taste, for in college he took the mechanical engineering course. After four years of the school work he went West, where he spent one year ranching in Colorado and one year on irrigation work in Idaho. By that time he had decided that the West was the proper place to live, and that a representative westerner should be a mining engineer. Anyway, this seemed more attractive than the lumber business, in which his father was engaged. So back he came to Montreal in 1893 and took a three-year course in mining engineering, graduating in 1896. Returning to the West immediately, he got a job as assistant chemist at the Pueblo smelter, in Colorado. At that time, E. P. Mathewson was superintendent, W. H. Howard assistant superintendent, and E. H. Hamilton chief chemist. Incidentally, all of these men were McGill graduates, so the new recruit was not made to feel exactly like a stranger. A promotion to chief chemist soon came to Mr. Rutherford, a position which he held until late in the year 1898, when he went to Mexico as chief chemist for La Gran Fundicion Nacional Mexicana, at Monterey, then owned by the Guggenheims but now an American Smelting & Refining Co. plant. Eight months later he was transferred to an associated company, La Gran Fundicion Central Mexicana, at Aguascalientes, where he spent four years, the last three and a half being as assistant superintendent of the plant, under W. H. Hamilton. Returning to the United States in 1903, Mr. Rutherford secured a position with the Copper Queen Consolidated Mining Co. as assistant general superintendent of its new plant then being built at Douglas, Ariz. However, as it was not ready to start up, he returned to Mexico for six months, acting as smelter superintendent for another Phelps Dodge subsidiary, the Moctezuma Copper Co., at Nacozari, Sonora. In April, 1904, he returned to Douglas where he remained for thirteen years, during eight of which he was assistant general manager under George B. Lee, and for the remainder of the time general superintendent and metallurgical manager in charge of all operations and construction. During this time, the plant was remodeled, trebled in capacity, and the reverberatory furnace department added, the whole being brought up to a capacity of 20,000,000 lb. of blister copper per month—one of the largest copper ore smelters of the world, probably being exceeded only by the Anaconda and Garfield smelters. Reports of the excellent work being done at the Copper Queen soon spread, and Mr. Rutherford acted as host to a large number of visiting metallurgists, to whom his plant was always open. The Copper Queen and Calumet and Arizona smelters adjoining one another in Douglas made that town a metallurgical center. In January, 1918, Mr. Rutherford responded to the call of the effete East, deciding that consulting engineering work would be more congenial, after twenty-two years in the field. Although in the last two or three years consulting mining engineers have been starving to death in New York City (so they say while yet alive), Mr. Rutherford when last seen was standing up on both feet with his shoes polished. Among his other duties he has been retained as consultant by the Tariff Commission. Forest Rutherford was married in Pueblo, Colo., to Lillian Thatcher, on June 5, 1915. He is a member of the A.I.M.E. and the Mining and Metallurgical Society of America, usually attending the New York section meetings of both bodies. For recreation, he journeys to the hills of Long Island, where he is a member of the Engineers Country Club, at Roslyn. Sometimes Mr. Rutherford has been given credit for the work of a playwright by the same name, but he disclaims having any ability of that nature.

New Books

Seventeenth Century Metallurgy

El Arte de les Metales. Translated from the Spanish of Alvaro Alonzo Barba by Ross E. Douglass and E. P. Mathewson. John Wiley & Sons, New York City. $3.50.

Mining engineers of the present day certainly are not obliged to remain in ignorance of what their predecessors have done. Not so long ago, Mr. and Mrs. Hoover translated Agricola and now comes the present English translation of Barba's work.

The book under review was written by a priest and metallurgist, a rare combination these days if not then, who lived in Potosí, Bolivia, three hundred years ago. The first third of the book treats of "the manner in which ores are begotten, and the things that accompany them." This we found easier reading than the remainder, which is almost entirely devoted to the details of assaying and treatment of the ores of the district in which Barba lived. Many of the strange superstitions of earlier days still persisted in the seventeenth century. For example, we were interested in the earth *Lemnia*, similar in appearance to red ocher, which was "sold at its weight in gold and this price is due to the esteem in which it is held and the common belief that it is very rare in the world. . . . It is mined only one day in the year, the sixth day of August, as they believe that only what has been mined on that day is possessed of virtue. It is an admirable antidote against whatsoever kind of poison or pest."

Belief in transmutation was still general when the book was written. "In this circumstance there is visible proof that one metal may be transmuted to another, namely, that if copperas" [meaning copper sulphate, and not ferrous sulphate, as is now understood by the term] "be dissolved in water, it will at once, without further artifice, turn into fine copper not only iron, but lead and tin as well." The origin of this belief is of course apparent. Another reason why the transmutation of metals was so widely accepted was because chemical analysis was in a crude state, and a metal might be made which would pass all the then-known tests for another, but which would really be something quite different as viewed in the light of present-day knowledge of chemical composition. Transmutation was really considered a natural phenomenon, for "by art, wasps and beetles are produced out of manure; and out of sweet basil, placed and treated, are produced scorpions. And it is a well-known fact that in Scotland, out of the pieces of the beams of ships, and out of fruit fallen into the sea, ducks are produced." It was the idea, as we get it from Barba's record, that metals gradually transmute themselves, grow from one to another, finally appearing as gold. "The fact is that man, in his greed, snatches the metals out of their veins before they are ripe."

Metallurgy and medicines were closely connected in the olden days, and Barba gives many illustrations of the virtues of the metals and their compounds in curing disease. "Itch cure," for instance, "consists of two parts of copperas and one of litharge; they are ground and mixed in a little strong vinegar, and left in dung for forty days. The mixture is then toasted in an earthen pot until it becomes very red." And present-day manufacturers of beauty clay are but taking a hint from the old-timers: "The earth called *Chia* is white, inclined to be ash-like, and is like unto that of Samos. Among its qualities is that of removing wrinkles from the face and imparting a good color and radiance thereto."

It is really quite surprising how intelligently metallurgists treated gold and silver ores three hundred years ago, considering the lack of apparatus and the almost entire absence of a knowledge of chemistry as we know it—we hesitate to say a knowledge of true chemical principles, for how will our practice look in 2223? Barba describes many processes and furnaces in great detail, and there is no little practical sense in what he says. He tells of his discovery, among other things, of what we know as pan amalgamation. Furthermore, Barba gives much advice which applies today as well as when written. For example: "If the vein is very strong, and shows some signs of gold and silver, even if it does not from the start yield sufficient ore to pay expenses, the miner should follow it and deepen his workings enthusiastically, as in few kinds of labor can such great and certain hopes be entertained of great profit." Again, "The treatment of ores should not be practised except by him who understands it, and after examination and license of the authorities." The last part of this statement is still open to question: one can see the idea is not new.

The translators seem to have done their work well; they have kept the spirit of the original and yet put the text in readable English. Proof-reading errors seem to be confined to the third line from the bottom of page 11. It is difficult to see why the English spelling of the word "color" should be used in an otherwise American book, but this, we suppose, is a matter of taste.

EDWARD H. ROBIE.

South America as a Land of Industrial Opportunity

Industrial and Commercial South America. By A. S. Peck. E. P. Dutton & Co., New York. $5.

Anglo-South American Handbook. By W. H. Koebel. The Macmillan Co., New York. $7.50.

It is rare that two books on the same subject, both by experienced writers, should reach the reviewer's desk at the same time. In the present instance, however, and in spite of the similarity in the subjects discussed, it is evident that only a comparatively small amount of overlap has occurred, insufficient to detract from the value of the two volumes when considered as a complementary source of reference data and information.

As a preliminary, it might be suggested to the publishers of "Industrial and Commercial South America" that the book was written primarily to serve a utilitarian purpose and the labor required to cut leaves in a new volume is given grudgingly in these days of the mechanization of labor. Ragged edges may look artistic, but they are out of place in a reference book. Be that as it may, Miss Peck, who is a traveler of note and an observer of experience, has a sense of proportion. The result is a well-balanced review of the main features of each country, its resources and industrial activity, the types and characteristics of the inhabitants and their attitude toward the labor problem, the opportunities for industrial expansion and investment, the commercial atmosphere, and the facilities for transportation. In these days of irresponsible publicity, using books as a medium for self-expression, it is gratifying to note that exceptional care seems to have been taken in the present instance to insure uniformity and correctness in the spelling and accenting of words and names. The value of the book is enhanced by the inclusion of a number of maps. Reference is facilitated by the use of the boldface type at the beginning of paragraphs. The volume concludes with a chapter on trade in South America, which should be read carefully and taken to heart by exporters in the United States. Information is given dealing with living conditions and customs, postal regulations and other pertinent and miscellaneous data.

Mr. Koebel's handbook is the more businesslike volume of the two; it is a second edition, the first having been published in 1921. The acknowledgments in the preface indicate that every possible source of information and opinion, no matter how exalted, was tapped to good purpose. A comprehensive index follows the preface, which is where it should appear to facilitate reference. Unlike the companion volume, this handbook includes Central America, Mexico, and Cuba, and is therefore more useful than its title implies. Each country occupies a section, the author having condensed into small space adequate reference to geography, climate, history, constitution, and other varied information of interest to commercial houses. A feature of these accounts is the inclusion of statistics, and personal references to those in control of important industrial operations. Part II deals with shipping, Part III with cable, wireless and telegraph facilities, and Part IV principally with matter of particular interest to British oversea traders. A bibliography of works, in English, on South America is appended. As with Miss Peck's volume, it is evident that especial care has been taken to insure accuracy. A. W. ALLEN.

MEN YOU SHOULD KNOW ABOUT

H. C. Dudley, of Duluth, is now at Pasadena, Calif.

John H. Mackenzie, of San Francisco, has been to Tucson, Ariz.

Roy J. King has been appointed consulting engineer for the Hilltop Nevada Mining Co.

E. Horton Jones, of Nicholasville, Ky., was in New York and Boston last week on business.

George A. Denny is returning from South Africa to London. He expects to go to Canada soon.

W. Lee Heidenreich, who recently returned from Santiago, Cuba, has gone to Oklahoma to examine oil properties.

Edwin T. Hodge, professor of geology in the University of Oregon, has returned to Eugene from a visit to Palo Alto, Calif.

F. W. McNair, president of the Michigan College of Mines, at Houghton, has returned from a visit to Washington and New York.

F. B. Weeks, formerly geologist for the U. S. Smelting, Refining & Mining Co., has opened an office in San Francisco, at 211 to 212 Sharon Building.

Robert Linton and **Allen Rogers**, directors of Seneca Copper Corporation, recently paid a visit to the property, inspecting the work both underground and on surface.

Clyde Heller, president, and **Fredrick Bradshaw**, general manager, of the Tonopah Belmont Development Co., have been in Tonopah.

E. W. Hopkins, of Ironwood, Mich., manager on the Gogebic Range for the Oglebay-Norton Co., has returned from a month's vacation at New Smyrna, Fla.

G. H. Sharrer has left San Francisco to assume charge of the gold-dredging operations of the Mount Elbert Gold Dredging Co., near Leadville, Colo.

K. N. Phillips, in charge of the Oregon district for the U. S. Geological Survey, has transferred his headquarters from Portland to Medford.

D. E. Sutherland, assistant general superintendent of the Oliver Iron Mining Co., has returned from his winter home at West Palm Beach, Fla., where he has spent the last six weeks.

Frank Holz, secretary for the last ten years of the Yukon Gold Co., at Dawson, Klondike district, has left for the Malay Peninsula, where he will fill a similar position in connection with the company's tin dredging operations there.

A series of lectures on petroleum geology was begun on April 1 at the University of Chicago by **K. C. Heald**, chief of the petroleum section of the U. S. Geological Survey. The series will be concluded on June 12. **J. D. Sears** will be in charge of the Survey's petroleum section during Dr. Heald's absence.

A banquet in honor of **E. P. Mathewson**, recently elected president of the A.I.M.E. was held at the Hotel Utah, Salt Lake City, by the Utah Section of the Institute on March 19. A. B. Young presided. The committee in charge of arrangements consisted of Mr. Young, Earl Pembroke, C. T. Van Winkle, W. A. Wilson, and Ernest Gayford.

Roy A. Bowen, of Hamilton, Wis., superintendent of the Ottawa mine, has been transferred to Crystal Falls, Mich., to succeed the late Arvid Bjork as superintendent of the Bristol mine. Until it shut down, Mr. Bowen was superintendent of the Fortune Lake mine, which is a little west of the Bristol. Then for a time before going to the Gogebic Range he assisted Mr. Bjork.

Mining and metallurgical engineers visiting New York City last week included: **J. C. Ralston**, of Spokane; **C. Mason Farnham**, of Barre Plains, Mass.; **T. Lindsley**, of Homestead, Ore.; **J. F. Foran**, of Cerro de Pasco, Peru; **Fred L. Wolf**, of Mansfield, Ohio; **S. H. Hamilton**, of Philadelphia; **Fletcher H. Wood**, of Tampico, Mexico; and **Frank A. Crampton**, of Santa Monica, Calif.

SOCIETY MEETINGS ANNOUNCED

Industrial co-operation in various phases will be discussed at an informal conference of leaders in the mining industry to be held on April 27 at the Bankers Club, in New York City, under the auspices of the American Mining Congress, which at its last convention created a special division to develop this subject.

Invitations have been sent 150 men prominent in mining affairs, and acceptances are already arriving in sufficient volume to assure entire success of the conference. In addition, members of the committees on industrial co-operation established by the congress in twenty states will attend the conference. Speakers will include not only mining men but industrial leaders of other lines who have had experience with various plans of co-operation between employers and employees.

Sidney J. Jennings, president of the American Mining Congress, who has issued the invitations, will preside at the conference, which will be informal and will begin at 12:30 with a luncheon, continuing the discussions throughout the afternoon. W. A. Grieves, national chairman of the Division of Industrial Co-operation of the Mining Congress, will present the objects of the movement and the foundation which has been laid by the members of the division for its work.

John D. Rockefeller, Jr., has been invited to attend and to speak of the co-operative work of the Colorado Fuel & Iron Co., particularly in the results of employees' representation. Among other invited speakers are Norman Schlitcher, of the Y. M. C. A.; Arthur Young, of the International Harvester Co.; M. Y. Ching, of the United States Rubber Co., and W. W. Atterbery, of the Pennsylvania Railroad.

Among acceptances received are those of S. D. Warriner, H. W. Seaman, C. F. Kelley, George Stahl, C. H. Jenkins, Robert Linton, Otis Mouser, J. G. Bradley, Lee Long, Frank Rash, Merrill Baker, William Loeb, W. J. Loring, H. Y. Young, Albert Mason and Carl Scholz, representing coal, copper, zinc, iron, and various other mining interests.

The aim of the Industrial Co-operation Division of the American Mining Congress is to develop improved relations between employers and employees for the mutual benefit of both as a purely business arrangement. It is proposed to avoid carefully the pitfall of paternalism in developing the work. The plan is to study the various systems in operation at different plants, in varied lines of industry, in the United States and abroad, with an exchange of ideas and experiences so as eventually to evolve a general system, elastic in nature, to fit differing physical conditions and other factors, which may be recommended to the mining industry as a whole.

Committees have been appointed and are functioning in twenty of the twenty-two mining states embraced in this plan. The state committees operate under the direction and in co-operation with the national committee, or division, of the American Mining Congress.

Questionnaires have been sent operators in the twenty states by the state committees, asking whether they have in effect a plan of co-operation with employees, the nature of the plan, its results, and various other information. As the questionnaires were only recently issued, replies have not been compiled, but general tendencies will be considered at the New York conference. This division was launched by the American Mining Congress last fall. It is expected that at the 1923 congress, the division will be able to report considerable progress as the result of its questionnaires and other investigations and activities.

OBITUARY

Eugene Louis Giroux, sixty-six, for many years prominently identified with mining interests in the Southwest, died March 30 at his home, at Pelham, N. Y. He was born in Chicago. At an early age he went West, where for a number of years he was interested in ranching enterprises in Utah and Idaho. Later he became interested in the development of western railroads with the late E. H. Harriman. Mr. Giroux was formerly vice-president of the Giroux Consolidated Mines and owned mining properties in Mexico, Arizona and Nevada. He was a member of the American Institute of Mining Engineers.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

JULY 1 is named by the Director of the Mint, after a conference with the principal silver refining interests, as the probable date of the "completion" of the repurchases of silver under the Pittman Act. Whereas recent official reports have shown about 40,000,000 oz. yet to be purchased, the director's latest figure is 20,000,000. The discrepancy is explained.

Messrs. McLean and Carey are equipping a plant at Leadville, Colo., to treat low-grade zinc-iron ores by preferential flotation.

Shipments of concentrate from the Joplin-Miami district have exceeded $1,000,000 weekly for five successive weeks.

The Utah Copper Co. has decided to equip its steam shovels with caterpillar tractors to economize on men.

Zinc smelter at Henryetta, Okla., will be restarted.

Payment for zinc in custom ores received at the Trail smelter, in British Columbia, has been cut.

The Phelps Dodge Corporation has started an additional furnace at the copper smelter, at Douglas, Ariz.

The Anaconda company is producing metallic cadmium at Great Falls.

The successful financing of the improvements to the Salt River power development, in Arizona, assures continuous power to the mines of Globe, Miami, and Superior.

Mint Director Confuses Miners with Pittman Act Statement—Says 20,000,000 Oz. Will Complete Repurchases

Includes Silver "in Process" in Purchases to Date—Unexpectedly Deducts 10,000,000 Oz. Used for Subsidiary Coinage—Names July 1 as Final Date of Purchase After Conference with Principal Vendors

By Arthur B. Parsons
Assistant Editor

SOMETHING of a bombshell was thrown into the camp of domestic silver producers on Friday, March 30, when the Director of the Mint announced that purchases of silver by the government at $1 per ounce under the terms of the Pittman Act would probably be discontinued on or about July 1, 1923.

The estimate that July 1 will mark the end of the purchases is based on the statement that only 20,000,000 oz. remain to be purchased and the fact that future tenders of domestic silver to the director will probably be at the rate of from 6,500,000 to 7,000,000 oz. per month.

On March 24 the director announced officially that 167,557,068 oz. had been repurchased under the terms of the act. As the total amount of silver to be purchased has always been given as approximately 208,000,000, there remained apparently about 40,000,000 oz. to complete the purchases.

Miners from the West naturally are greatly wrought up over the discrepancy, and telegrams have reached us asking for an explanation. The difference of about 20,000,000 oz. is accounted for in two ways:

First. Pursuant to an opinion rendered by federal legal advisers, and in conformity with authority granted by the Pittman Act itself, the director has decided to deduct from the total amount authorized to be purchased about 10,000,000 oz. representing silver which was utilized by the government for the making of subsidiary coinage. Sec. 3 of the Pittman Act says: "The allocation of any silver to the Director of the Mint for subsidiary coinage shall, for the purposes of this act, be regarded as a sale or resale."

It appears that the director has just decided to take advantage of this provision of the act, on the ground of government economy, to the disadvantage of the silver producers. This decision came as a distinct surprise to everybody concerned.

Second. The other 10,000,000 oz. represents silver now in the process of smelting and refining, which is subject to the Pittman Act price and for which the smelters and refiners hold the necessary affidavits as to domestic origin from the mining companies. These figures were obtained from representatives of the American Smelting & Refining Co., the United Metals Selling Co., the United States Smelting, Refining & Mining Co., the Bunker Hill & Sullivan Mining & Concentrating Co., and the Nichols Copper Co.

These companies are the vendors of 95 per cent of the silver tendered to the mint, and the announcement of the director followed a conference in Washington with their representatives.

Obviously, this metal has not been delivered to the mint and in a sense it is misleading to deduct it from the amount that remains to be purchased.

The reason that the director has deducted it probably is because so far as future mine production is concerned this metal has precedence. It seems to be the plan of the Director of the Mint to determine the salability of a lot of silver by the date on which the ore or concentrate containing it was delivered at the reduction works, rather than by the date on which the marketable bullion is offered to the director for purchase. In other words, the miner of siliceous silver ore who produces marketable cyanide bullion a week after his ore leaves the mine is to enjoy no advantage over the producer of zinc-lead-silver ore whose silver is not ready for the market for six months after it is mined. The approximate date of mining the ore, not of marketing the bullion, is to control the precedence of purchases.

The Director of the Mint has arranged that the large vendors shall, after the quantity remaining unpurchased has reached 10,000,000 oz.,

notify him each day as to the quantity of silver (in base bullion ore or concentrate) received by them. These amounts will be considered as "tendered" to the mint for purchase subject to future delivery and when the total of 208,000,000 shall have been reached, (or 198,000,000 under the new ruling) purchases will automatically cease. This should occur about July 1, according to the estimates made by the director.

Whether these tenders for future delivery shall take precedence over actual tenders of silver bullion at the mint after the 198,000,000 point has been reached on paper, does not seem clear, but apparently they will.

As a matter of fact the smelters and refiners have been given until Oct. 1, 1924, to complete delivery of the silver that will be paid for under the terms of the act.

The smelting companies agreed informally at the conference in Washington that, when the time arrives at which it cannot accurately be told whether the Pittman Act price can be obtained or not, they (the smelting companies) will simultaneously cease paying the Pittman Act price and will begin making provisional settlements on the terms applicable under their respective contracts to silver not salable under the Pittman Act, with the understanding that the department will continue to receive tenders, conditioned upon its ability to complete the purchase under the act, and that, when all the figures are in and the actual date of termination can be determined, all shipments qualified for sale under the act will be reliquidated and the Pittman Act price paid therefor.

The date at which provisional settlements will begin will probably fall in May. The date of reliquidation of silver salable at the Pittman Act price will be as soon as the exact date of termination of the act is known.

The official statement of the director to the important vendors says:

"In order to effect, as nearly as is practicable, a simultaneous discontinuance of the payment to the miners of $1 per ounce, it is proposed that the following procedure govern:

"Establish the government's actual receipts of silver from each large vendor and from miscellaneous sources as of Dec. 31, 1922; the large vendors to establish their refinery and smelter inventories of silver supportable and salable by them as conforming to the act of April 23, 1918, as of Dec. 31, 1922, and as of the close of each subsequent month to include March, 1923. The amount covered by such inventories to be separately stated as to the silver not tendered to and accepted by the Director of the Mint and the amount subject to delivery on accepted tenders. The Director of the Mint to accept from these large vendors, on tender, these inventory quantities not previously accepted, for delivery as and when refined. Such monthly inventories and tenders to be continued until such time as the Director of the Mint publicly announces that the quantity remaining purchasable by the government has reached approximately 10,000,000 oz., after which these large vendors will be expected to tender the Director of the Mint by telegraph, each day, the amount of silver received at reduction works (smelters or refineries), which is salable by them as conforming to the terms of the act of April 23, 1918.

"Deliveries to the mints upon all accepted tenders must be made on or before Oct. 1, 1924. The Director of the Mint to make public announcement of the day on which purchases under the terms of the act of April 23, 1918, cease.

"The Director of the Mint will continue to purchase at the mints heretofore receiving deposits of silver for payment at the rate established by the act of April 23, 1918, such silver up to the amount remaining to be purchased under the act cited as is tendered thereto in gold deposits, and small lots of refined silver when properly supported as to evidence of domestic production."

Producers have known all along that a large quantity of silver is tied up in the various stages of metallurgical treatment, and accordingly that they could not expect $1 for silver sold to the smelting companies up to the time the entire 208,000,000 had been purchased.

The only unforeseen development is the decision of the Director of the Mint to diminish the total repurchases by the amount of silver used for subsidiary coinage, namely 10,000,000 oz. This means a loss of about $3,000,000 to the producers of silver. As the former director of the mint reported officially that the repurchases would total approximately 208,000,000 and many mining companies have planned their operations on that basis, the action of the officials at this late date seems unfair, even if technically justified by the letter of the law.

The interpretation of the concluding paragraph of the recent statement will be important to the small independent vendor. Will he be able to deliver bullion to the mint after July 1, or whenever the nominal tenders reach the total to be purchased, and receive the Pittman Act price? This remains to be seen.

Utah Copper Operates Steam Shovels Equipped With Caterpillar Tractors

The Utah Copper Co., after experiments made with two shovels, is preparing to equip the entire number of shovels employed at its Bingham Mines with caterpillar tractors. The shovels so equipped have been giving good service. The new equipment will preclude the necessity of laying rails in the pit ahead of operations, and will release the four men employed in this work, so that the new installation in addition to offering a more practical method of operation will be a labor saver as well.

Plan to Treat Low-Grade Complex Ores at Leadville, Colo.

Selective Flotation Will Produce Two Marketable Products—Zinc Predominates in One, Iron in Other

Claiming that after two years of metallurgical research they have solved the problem of successful treatment of complex zinc-iron ores of the Leadville district, Messrs. McLean and Carey are installing at the old sampling works in California Gulch equipment for treating about 75 tons of ore daily. This installation is to be the pilot plant for a mill of several hundred tons' capacity.

Only reasonably high-grade ores of this character can be profitably mined in this district, as much ore contains too much zinc to make it acceptable to the smelter, where it is penalized to cover cost of fluxing, and too little zinc to make it acceptable to the oxide plant. The new process is a method of selective flotation whereby the zinc will be floated out of the iron and silica mixture, and then in a second stage the iron containing other values will be floated, leaving a comparatively barren quartz and limestone tailing.

It is claimed that there is enough ore of this character in the Leadville district to run a thousand-ton mill ten years and that by a separation of the minerals such as described between $8 and $12 per ton will be added to the value of the ore.

It is expected that the plant will be ready to treat ore about April 15. It will handle about 75 tons daily. If successful, as soon as details can be worked out, the plant will be enlarged to treat 200 tons daily.

"Consolidated" Cuts Payments

The Consolidated Mining & Smelting Co. has issued the following circular to shippers of custom ore to its smelter at Trail, B. C.:

"Effective March 15, 1923, we will amend Schedule A, zinc-ore rates, so that when the zinc quotation in London exceeds £24 10s. we will deduct from the quotation one-quarter of the amount by which it exceeds £24 10s. in addition to other deductions provided in the schedule. Below £24 10s. the rates remain unchanged. For instance, if the market is £34 10s. settlement will be based on £34 10s., less one-fourth (£34 10s. — £24 10s.) = £32. The amendment has been made necessary by the fact that subsequent to the publication of Schedule A wage adjustments have taken place under which the wages upon which this schedule was figured increase as the market increases over £24 10s."

Mine Employees in Broken Hill (Australia) Grow Restless

Growing unrest is reported by Reuters among the mine workers in the Broken Hill district, in Australia, owing to the delay of the mine managers in acceding to the men's requests to discuss their claims for increased wages and revised working conditions.

World Sulphur Producers Reach Agreement in London

American and Sicilian Interests Divide Markets and Plan Price Regulation

Representatives of the American sulphur-mining industry have signed an agreement with the Sicilian sulphur consortium, regulating the world's sulphur market. The agreement is valid until Sept. 30, 1926, and may be renewed. It concerns chiefly sales prices, and assignment of markets to the contracting parties. Prices are to be regulated in relation to consumption demands, with the aim of attaining gradually the pre-war level on the gold standard. Prices are to be increased by $1 a ton over those temporarily fixed in conjunction with the American producers in October last, according to the *Boston News Bureau.*

North America has been assigned to the American producers; and the Italian markets are to be allocated to the Sicilian producers. The remainder of the world has been proportionately divided between the two, with provision that Sicily may sell to any country a maximum of 65,000 tons for the manufacture of sulphuric acid. The agreement permits Sicily to export annually a total of 210,000 tons, including 65,000 tons of sulphuric acid. This export is largely in excess of Sicilian exports in recent years. The export agreement relates solely to unrefined sulphur. Export of refined and ground sulphur is left entirely free.

A Central Bureau will have headquarters in London, with representatives of the contracting parties appointed for the exchange of information and statistics for the execution of the agreement. Exportation of raw sulphur to individual markets will be regulated by taking into account, so far as possible, the advantages accruing to each producer from its geographical position in relation to countries that consume the product.

The agreement may be dissolved before 1926 by not less than six months' notice, but rupture must not take place during the sulphur selling season. Disagreements will be submitted to a London Board of Arbitrators, composed of a representative of each of the parties and the third named by the first two, or in default of this, by the President of the Chamber of Commerce.

It is believed the Italian Government has had to sustain by subsidy the Sicilian production against American competition, as a large population has been engaged in producing sulphur the production cost of which would yield large profit if realized by sulphur producers in Texas.

The Texas Gulf Sulphur Co., which, from its huge supplies, produces at low cost, can undersell the world. It has initiated a scientific research department under expert management to find uses for sulphur, expanding consumption in the United States and throughout the world. This is the real sulphur problem.

Only One American Woman Prospector in Mexico

So far as known, Miss Rosa Morgan, of San Buenaventura, is the only American woman mining prospector in Mexico. She has made a special study of mineralogy and geology, and much of her time is spent in prospecting for gold and silver in the mountains of this remote part of Chihuahua. Recently she discovered outcroppings of rich ore in the Escondida Mountains, and after staking the claims she filed formal application for title to a group of ten claims which she plans to develop. She has named the group El Gran Bonanza.

Rich "Rock" Cut Lake Superior Copper Company Deficits for 1922

Reports Show High Yield—Costs Reduced by Efficient Mining—Close Selection

Notable increases in copper content of the ore hoisted feature the annual reports of Michigan producers made public to date. Calumet & Hecla's yield in 1922 was 47.08 lb. per ton, which was 9.35 lb. more than in 1921, 19.21 more than in 1920, and 23.17 more than in 1919. Ahmeek's yield was 33.85 lb. per ton, compared with 29.48 in 1921, 24.9 in 1920, and 22.8 in 1919. Isle Royale's yield was 26.92, as compared with 21.37 in 1921, 17.37 in 1920, and 17.95 in 1919. Cost per ton, in each case, was lower in 1922 than in any of the preceding three years.

The increased yield shows the extremity to which the mines were pushed throughout the period of relatively low prices for the metal. To reduce deficits to a minimum it was necessary to introduce almost revolutionary changes in underground methods to bring yield up and costs down. More attention was accordingly paid to stoping details, and closer selection was employed both in mining the vein and in rock assortment. Only high-grade rock was sent to the mill, and as a result reports so far submitted make a good showing.

Want Lower Freight Rate on Explosives in Arizona

The Apache Powder Co., whose plant is situated at Curtis, Ariz., has instituted action before the Arizona Corporation Commission, against all railroads operating in the state, charging that the rates exacted are higher than they should be, compared with rates charged for hauls of equal length in California. This appeal has been joined by that of many mining companies who are users of the powder and who are stockholders in the Apache Powder Co.

The action asks that any adjustment be made retroactive to the first of the year. C. E. Mills, president of the powder company, testified regarding the establishment of the plant and the subsequent arrangement of rates on intrastate shipments. Many prominent mining men of the state will testify, and it is expected that a readjustment of rates will be effected.

American Boy Will Build Tram and Mill

New Oreshoot in British Columbia Property—Mill Temporarily Leased From Clarence Cunningham

Edward T. Davey, one of the principal owners of the American Boy mine, in the Slocan, has just returned from the mine, and reports that an entirely new and important discovery has been made in a winze that was sunk from the No. 7 tunnel. The find really was made some months ago, but was kept quiet, as the company was anxious to acquire some adjoining property. These claims now have been secured, so there is no object in longer keeping the discovery secret.

At the face of No. 7 tunnel, 800 ft. from the portal, a winze was sunk, and at 60 ft. it opened a blind contact vein, that is an entirely new strike in the district. It is 6½ ft. wide, with well-defined walls and in porphyry formation. On the hanging-wall side there is 14 in. of silver-lead ore that along a drift of 30 ft. has averaged 210 oz. of silver and 70 per cent lead.

The company plans to erect a rope tramway and a mill during the coming summer. There is 30,000 tons of silver-lead ore that will net the company $40 per ton on the dumps; and the engineer reports that there is 60,000 tons developed in the mine that will average 30 oz. in silver per ton, 30 per cent lead, and 20 per cent zinc. Pending the erection of its own mill, the company has made arrangements with Clarence Cunningham for the milling of the ore. As soon as weather conditions allow a start will be made on the tramway.

Zinc Smelter at Henryetta, Okla., Will Be Restarted

Plans are being made for the early reopening of the Moore Mining & Smelting Co.'s zinc smelter at Henryetta, Okla. The smelter has five blocks of 600 retorts each, and will handle approximately 600 tons of concentrates per week. Repairs and improvements to the extent of between $20,000 and $30,000 are being made at the plant, including the installation of two new Ropp mechanical roasters, each 190 ft. long, and also a new pottery plant. A new roof has been installed, the entire plant has been repainted, and new track scales built. The plant has been down for over two year, being closed in November, 1920.

Foreigners Prospect Russian Gold Fields

It is reported by Reuters that the Okhotsk gold fields, in Russia, are being explored by American interests and that twenty American prospectors have already arrived. A British prospector is also reported to be making investigations there; and Herr Stinnes, the German capitalist, is negotiating with the Russian authorities to acquire the Kissilevsky gold fields, at Udil-Limursky, about 70 versts from Habarovsk.

Expansion of Salt River Power Project Financed

Mining Companies at Globe, Miami, and Superior, Ariz., Assured of Power All Year

The recent sale of the $1,800,000 bond issue of the Salt River Valley Water Users' Association to a Los Angeles syndicate assures the completion of the Salt River construction projects, now under way, which will make additional power available for the contiguous mining districts. This work consists in the installation of nineteen gates in the spillways of Roosevelt Dam, which will result in increasing the height of the dam 15 ft. and an added storage capacity of 270,000 acre-feet of water in flood seasons, and the erection of another dam at Mormon Flat, 27 miles downstream. A new generating unit of 7,000 hp. capacity will be installed at the Roosevelt plant, which will make a total of 20,000 hp. available for distribution. The Mormon Flat Dam will be 160 ft. high and will hold 90,000 acre-feet.

The construction of the second dam below Roosevelt will assure continuous power for the mines of the Globe-Miami district and Magma Copper Co., at Superior, which are the largest consumers. Heretofore power has been generated only when there was a surplus of water or as the water was required by the Salt River Valley irrigation projects, and was subject to seasonal variations, but with the storage facilities afforded by the new reservoir, water may be steadily discharged through the turbines and held in the lower lake until needed for irrigation.

The erection of the gates in the spillways of Roosevelt Dam, which was started immediately after the authorization of the bond issue, is now nearing completion. The added height to the structure will cause a great area along the present shore of the lake to be flooded and it is necessary to reconstruct a portion of the county highway at a higher elevation and move the Apache Lodge and other buildings. It is expected that this work will be completed by April 1. F. A. Reed, president of the association, has announced that the entire project will be finished by Jan. 1, 1924.

Activity in Australasian Mining Industry

By Cable from Reuters to "Engineering and Mining Journal-Press"

Melbourne, March 29—The recent advances in metal prices have resulted in an increase of activity in local properties, particularly in Tasmania. Work has been started on the Zeehan portion of the Jupiter zinc and lead mine.

The Mount Bischoff Tin Mining Co. is now making a scientific investigation in an effort to discover the downward continuation of the rich orebodies.

The Carpathia tin mine, in New South Wales, is about to start a vigorous policy of development, including the sinking of the main shaft.

Silver Producers Urge Building of South Lorrain-Cobalt Railroad

A movement is under way to persuade the Ontario Government to extend a branch line of the T. & N. O. Ry. into the South Lorrain district. Developments there have been remarkable, and the Mining Corporation and Keeley mines are heavy producers, with assurance of a considerable life. During the first three months of this year the Mining Corporation produced over 500,000 oz. of silver, and in March Keely shipments were over 300,000 oz. There seems to be little doubt that other producing properties will be opened up and that the district will be an important mining centre for some time to come. The mines are 23 miles from Cobalt, and a branch line in addition to serving them would also open up a partly settled farming district. With the decline in production of the Cobalt mines, there is plenty of milling capacity available and with a railroad and a reasonable freight rate on ore it is reasonable to assume that a large part of the South Lorrain tonnage would be shipped to Cobalt for treatment.

New Smelter at Monclova, in Coahuila, Mexico

Construction of a smelter will be started at Montclova soon by Juan Castillon and associates, it is reported. The recent completion of an extension of the Monclova-Cuatro Cienegas branch line of the National Railways of Mexico from Cuatro Cienegas to the mining camp of Sierra Mojada caused Monclova to be selected as a site for the location for the proposed plant. Special concessions in the way of the low freight rates on ore and other grants have been given the promoters of the project. It is stated that American mining men are associated with Mr. Castillon in the enterprise.

News from Washington

By PAUL WOOTON
Special Correspondent

International Controversy Arises from South African Gold-Field Claims

"Barbarian" Brown's Dealings With Oom Paul Over Mining Ground Caused Boer War—Estate Seeks $1,800,000 From Britain

ON the ninth of next July, at The Hague, the British-American Pecuniary Claims Arbitration Board will assemble for the purpose of taking up the consideration of claims of the United States against Great Britain and Great Britain against the United States. One of the most important of these cases arises out of the Boer War of twenty years ago. It is the case of "Barbarian" Brown, formerly of Spokane, Wash., and it is this claim which is regarded as the *casus belli* of the Boer War. Brown, whose full name was Robert E. Lee Brown, was a mining engineer and had been successful in the northwest. In 1893 he emigrated to South Africa, and in 1895 drifted into the district of Potchefstroom. The Boer government was about to throw open for location and development the area known as Farm Wilfontein. It was presumed that the main lode of the now famous Witwatersrand vein transversed the property, but before anyone could file a claim he had to obtain a miner's license for each claim filed. It was officially proclaimed that the clerk's office would be opened for the issuance of licenses at Doornkoop at 8:30 a.m. on the morning of July 19, 1895. This office was 20 miles from the farm. There was a stampede, but partners were left on the farm ready to stake on receipt of news that licenses had been granted. Brown was a wise prospector. He had been there before. He had picked out 1,200 locations and had his men camped on them. He didn't know at the time that 700 choice claims had already been located by relatives of Paul Kruger, then the dominant force in South African politics. Brown did not depend on horses, and there were no automobiles in those days, but he secretly installed a heliographic apparatus to flash signals to his partners immediately on the granting of licenses.

When Brown approached the office on the morning of July 19, the day fixed for the granting of licenses, he found that the office had been surrounded by a compact crowd of Boers, who were evidently determined to keep the Americans and British out. But Brown called a meeting. He selected a dozen American mining men who had been football players and he formed a flying wedge and finally reached the clerk's office about 8:30 and demanded 1,200 licenses. The clerk demurred. He would consult his superiors; and then he announced that the opening hour had been postponed until 10:30. Brown insisted that the money which he offered should be accepted, but the Boer refused and finally slammed the door in his face. This created a near riot among the British and Americans, but Brown, anticipating something of the kind, had obtained legal advice, and after making the tender ran to his heliograph, where he signaled to his associates to go ahead with the staking. The Boer Government refused to acknowledge the legality of the staking and later issued grants to Boers on a lottery basis.

Brown carried his claim to the high courts of South Africa, and when the judges of those courts rendered decisions in his favor, Oom Paul promptly displaced all the judges and refused to allow the court order to be executed.

This is where John Bull, who is a great believer in the inviolability of contract, stepped in. The treatment accorded by the South African Government to the American engineer served as an additional reason for the British punitive expedition against the Boers.

Brown had evidence to show conclusively that he had an offer of $1,500 for each of his 1,200 claims, the money to be paid the instant he could show title, and in view of the fact that the outcome of the Boer War was the transfer of the sovereignty of the Boer authorities in South Africa to the British, the estate of "Barbarian" Brown claims that where the sovereignty of one country is transferred to a conquerer as the outcome of hostilities, the conqueror becomes responsible for any outstanding obligations of the conquered to a neutral third party. This claim aggregates $1,800,000. All the British books dealing with evidence that culminated in the Boer War cite the Brown case to justify the British aggression, and liberal quotations from these books adorn the pages of the memorial to the British-American Pecuniary Arbitration Board.

The British do not attempt to deny the facts in the case, but they set up in their answer that there are "no precedents to show that the conqueror is bound by the rules of international law to undertake the obligations of a conquered state."

Alaska Railroad Now Complete—Line 467 Miles Long

With the completion of the large steel bridge over the Tanana River, the Alaska Railroad is practically complete, the Secretary of the Interior announced on March 30. The Governor of Alaska and the Alaskan delegate to Congress have joined in asking the President and the Secretary of War to allow Colonel Frederick Mears to remain in Alaska until Sept. 1. As the Commissioner at the head of the Alaskan Engineering Commission, Colonel Mears has become so familiar with the work that those interested in the Alaska Railroad are anxious that he remain on the ground during the summer so as to be in charge of completing the engineering phases of the construction work. In announcing the completion of the Tanana bridge, the secretary says:

"Both passenger and freight traffic are now running over the bridge, and the only work still to be done upon the line involves minor construction in connection with the standardization of the roadbed above the bridge to Fairbanks. This is expected to be completed within the next two months.

"The Alaska Railroad is the first railroad of any size ever built and operated by the United States Government."

Industrial Railroad Has Not the Privileges of a Common Carrier

Inland Crystal Salt Co., in Utah, Incorporated Company to Own Plant Line; Empty Form, Says I.C.C.

The Inland Crystal Salt Co. and the Inland Railway Co., of Utah, are in effect one enterprise, the Interstate Commerce Commission has ruled in a formal opinion handed down March 30. "The separate incorporation of the Inland Railroad," says the decision, "did not change the status of the operations theretofore conducted by the Salt company. The mere fact of incorporation cannot transform a plant facility into a common carrier. While the extent to which the public uses the facilities of a railroad is not controlling, there must be some appreciable use of the railroad by the public, or else the holding out to carry for all is merely an empty form. This is obviously the situation here. The Inland never has handled shipments for shippers other than the Salt company. The territory near it is barren, and there is no immediate prospect of future traffic other than that of the Salt company."

The Inland Crystal Salt Co., which is a large producer of salt recovered by the solar process from Great Salt Lake, was shown to control the Inland Railroad, which had contended for divisions of joint rates and other perquisites of a common carrier. The commission finds, however, that the Inland "is not a common carrier, but an adjunct, or plant facility of the Salt company; that it is not entitled to receive a division of joint rates, and that the carrying of the crude salt to the refinery is merely a step in a manufacturing process and is not a transportation service for which the Salt company should receive compensation. This is not to say that it is unlawful for the trunk lines, including the Garfield and Western Railway Co., to pay reasonable compensation to the Inland for performing as their agent through its industrial railroad any portion of the transportation service beyond Saltair Junction customarily included in the interstate line haul rates which they do not elect to do for themselves."

Electric Point Mining Co. Gets Rebate

A large sum in reparations will have to be paid the Electric Point Mining Co., operating near Boundary, Wash., by the various carriers which transported 82 carloads of lead ore from Boundary to Midvale, Utah, in 1919 and 1920. The Interstate Commerce Commission has upheld the contention of the mining company, and, in a formal opinion, declared that the rates are unreasonable to the extent that they exceeded $8.80, $9.40, and $10.30 per ton on lead ore of values not exceeding $25, $50, and $100 per ton, respectively. The ore was hauled to Utah to be smelted at the plant of the United States Smelting, Refining & Mining Co. at Midvale.

Sutro Tunnel Will Be Extended Under Comstock Lode

Owners Must Fulfill Contract With Government or Surrender Rights—Story of the Project

Development of the celebrated Sutro tunnel, built for the purpose of penetrating and draining the famous Comstock Lode, in Nevada, from which over $325,000,000 in gold and silver was mined in the early 60's, is in prospect.

This information was made public by the Department of the Interior on March 22, after negotiations with New York interests now controlling the tunnel under a grant made by Congress to A. Sutro, his heirs and assigns. Under the provisions of the act the tunnel was to be constructed a distance of 7 miles in length, and exploiters of the mining property were given the right to buy at $5 an acre all mineral veins and lodes within 2,000 ft. of each side of the tunnel.

Construction of the tunnel was started in 1866 and continued for about 4 miles into the mountain, and further work was undertaken later by New York interests, but precious metals were not found in important quantities. Sufficient revenues were derived, however, to keep the tunnel in operation, although no steps have been taken since to extend it. The Department of the Interior recently notified the interests concerned that unless steps were taken to complete the tunnel the grant of mineral rights for the unbuilt portion must be waived.

The New York interests have just presented data to the department to the effect that a revival of mining and milling of ores is going on in land tributary to the tunnel, promising substantial revenue, and, therefore, announced their intention of beginning construction upon the extension of the tunnel within the next eighteen months. Upon their failure they agreed to quitclaim their interests granted by Congress to the United States after that time. The Department of the Interior has assented this proposal.

The Sutro tunnel penetrated Mount Davidson, in the heart of the celebrated Comstock Lode, which was discovered in 1859 by Theodore B. Comstock, geologist and educator. The mountain is 7,870 ft. high. The tunnel is 8 ft. high and 6 ft. wide. Many shafts have been sunk along its course into the mountain.

Freight Statistics Reflect Increased Mine Ouptut

The extent of the increase in activities at mines during the last quarter of 1922, as compared with the last quarter of 1921, is shown by the commodity statistics just issued by the Interstate Commerce Commission. During the fourth quarter of 1922 the Class 1 railroads of the country carried 171,355,343 tons of freight coming under the heading "products of mines." This is an increase of 30.58 per cent over the products of mines transported in the last quarter of 1921.

Bureau of Mines Devises Sponge-Iron Process in Utah

Successful production of sponge iron on a commercial scale has been achieved in a direct-fired rotary kiln at Silver City, Utah. This is the outcome of extended experimentation on the part of metallurgists in the employ of the Bureau of Mines. The furnace was that of the Tintic Milling Co. If cheap sponge iron can be obtained, it is believed that it will find large use as a precipitant for copper. The process also offers possibilities to the West in the reduction of its iron ores and in the making of steel.

War Minerals Claimants Get Awards from Commission

Subject to the approval of the Secretary of the Interior, the War Minerals Relief Commissioner has recommended awards as follows: Estate of Harvey W. Cowan, Chicago, $6,930.02; Olson and Bishop, Denver, $7,404.40; Charles E. and Edward E. Saunders, Jamestown, Colo., $329.50; L. S. Moore, Mount Vernon, Ore., $561. The claim of C. J. Leonard, of Imlay, Nev., was recommended for disallowance on the ground that commercial importance of his mining enterprise had not been established.

News by Mining Districts

By Special Correspondents in the Field

Johannesburg Letter

Employee Arrested for "Possessing" Diamonds—Rock Fall Accidental

BY JOHN WATSON

Johannesburg, Feb. 27—An employee of the Premier Diamond Mine, A. A. Eden, was arrested on Feb. 8 for being in unlawful possession of a tin containing 402 diamonds, valued at £3,500. The accused had been employed at the mine for about sixteen years as a diamond sorter and grease-table attendant. The stones were said to be of best quality and had been taken over a long period. Eden was allowed out on bail of £500, but was ordered to report daily to the police at Benoni.

Owing to heavy rains in the Transvaal and Free State the Orange River bridge at Upington, one of the longest in the subcontinent, was completely submerged on Feb. 17 and 18 to a depth of 3 ft. Heavy wash-aways are also reported between Prieska and Upington. As a result all railway traffic to and from Southwest Africa is suspended for some weeks.

In connection with the theft of bars of gold, in transit, from the New Modder mine to Germiston, per rail, on Feb. 15, one further arrest was made on Feb. 21. The police and C.I.D. are now offering a reward of £2,000 for information which will lead to the conviction of the guilty.

An inquiry into the causes of the fatal fall of rock at the City Deep mine on the night of Feb. 6 was held by the Magistrate for Inquests and the Chief Inspector of Mines. They found that the evidence does not show that the occurrence was due to any act or omission of a criminal nature or contravention of any statutory regulation on the part of any of the deceased or any other person.

J. H. Curle, well-known gold-mining authority, spent a fortnight in the Salisbury district, leaving there on Feb. 8 for Beira and Nyassaland. He takes an optimistic view of prospects on the Rand; if low working costs can be continued and extended he expects to see several of the older mines at work again and earning profits.

San Francisco Letter

Engels Report Encouraging—Natomas Company Operates Six Dredges

BY GEORGE J. YOUNG

San Francisco, March 23—The recent report of the Engels Copper Mining Co. is distinctly encouraging to its stockholders. The gross value of the 1922 production was $2,116,055, and total costs were $1,719,134, which latter figure includes depreciation, insurance, reserves, and development. The operating profit was $361,543, resulting in removing the deficit and other charges, and leaving a credit balance to profit and loss of $20,505.

The increase in the price of copper assures greater profits during the present year. If the company is lucky in securing additional labor the situation would seem to warrant the treatment of a larger tonnage than the present 1,000 tons per day. The adit tunnel is being driven at the rate of 350 ft. per month, and connections should be made with the Engels mine about the middle of the year.

The net returns of Natomas of California in its 1922 gold-dredging operations exceeded the previous year; the total was $457,401 for 1922, against $286,398 in 1921. Diminished costs were responsible for the favorable showing. The total ground dredged in 1922 was 15,789,493 cu.yd., not including 3,945,820 cu.yd. dredged on lands not owned by the company. The gold recovered from Natomas lands was $1,429,283 and from other lands $215,243. At the beginning of the year nine dredges were in operation and at present six dredges are at work. During 1922, lands were sold under contract for about $500,000 and about $345,000 was collected on the principal of these and former contracts. Additional sums, totaling $242,000, were collected in connection with the land operations of the company. Though in 1921 there was a net operating loss of $119,523 on the operations as a whole, 1922 showed a net operating profit of $229,438. This favorable result is due partly to a change in economic conditions and in a large measure to efficient management. The net loss for the year after deducting depreciation and exhaustion of mineral area was $615,405. Considering the inherent difficulties resulting from the company's adventure into systematic land reclamation, the present showing is as good as may be expected.

Articles of incorporation have been filed by the Mount Shasta Silica Co., which has acquired an area of diatomite in the northeastern part of Shasta County by purchase. The incorporators are local residents of Weed—R. P. Clark, Bruce Clark, W. J. West, A. D. Rockwood, Emory E. Smith, and others. There are at present five companies in California interested in the exploitation of diatomite. The future of this important non-metallic mineral is promising, and the local deposits are of sufficient extent to warrant prediction of the substantial growth of the industry.

Miscellaneous reports of minor operations continue to come in from mining districts, all of which indicate a healthy growth. Grass Valley is attracting a considerable share of attention. Apart from the North Star and Empire, the Idaho Maryland is now on a paying basis and the Brunswick has practically completed its unwatering program. Local reports indicate that approximately 1,500 miners are employed in the district.

MEXICO

Production Figures

The Secretary of Industry and Commerce has published the following figures as the production of metals in Mexico during the month of December of last year, the figures being in kilograms:

Fine gold, 2,086; silver, 250,408; copper, 6,932,423; lead, 14,508,882; zinc, 2,225,147; mercury, 7,161; arsenic, 40,583, and graphite, 503,686.

The figures indicate an important increase in comparison with those of the month previous, especially in the production of silver, copper, lead, zinc, and mercury.

The production during the month of January is as follows, in kilograms: Gold, 2,271; silver, 183,136; lead, 13,120,235; copper, 2,690,156; zinc, 534,337; mercury, 3,579; arsenic, 60,672; graphite, 506,005.

Explotadora Dividend Declared

The Explotadora Mining Co. has declared dividend No. 7 for 1922, being $13 per share. Payments are ready for distribution from the office at No. 1, Avenida Isabel la Catolica.

Chorro de Plata Reopened

S. J. Clausen, Jr., is opening up the Chorro de Plata mine, which is situated in the Morris mining district in Chihuahua. The survey is to be made by G. S. McKay, to reform the plans and set the monuments in proper place. The main workings on this property was formerly known as the Republica shaft. It displays a well-defined vein carrying excellent values in both gold and silver.

ONTARIO

Power Shortage Continues

Porcupine has experienced one of the worst blizzards of the season. This will delay the coming of spring weather, with a late break-up and a consequent delay in relieving the power shortage. There is also a possibility of still another cut if the weather does not moderate soon. The Dome is treating less than 400 tons a day, and the Hollinger is down to about 25 per cent capacity. The Northern Canada Power Co. is completing its work at the Sturgeon Falls installation, and it should be ready for the break-up, after which it is hoped that there will be no further shortage of power. The management of the Great Northern Power Co. says that it expects to have 2,000 hp. available for Porcupine by May 15 and a total of 6,000 available by July. Though this power will be a welcome relief, it will be of no benefit to the operating mines, as it is 50 cycle, whereas the Northern Canada is 25 cycle. There is also a strong belief that the Great Northern will not be able to deliver the power estimated. The plant is situated near a rise of land, with comparatively small drainage area, and the Montreal River has an unfortunate habit of getting extremely low in the summer time, with a consequent decrease in available power.

ARIZONA

New Furnace Started at Douglas

The Copper Queen smelter at Douglas is now operating four blast furnaces and two reverberatories, the fourth furnace having been blown this week. This should put the production of this plant at 11,500,000 lb. of copper per month. Concentrates are coming from the new concentrator at Bisbee and in increased quantity from the Moctezuma plant, at Nacozari.

Heap Leaching at Bisbee

Large heaps of leaching ore are being constructed at Don Luis, near Bisbee, of material from the Sacramento Hill project that is not adaptable to milling. It is planned to direct mine water through the pile of low-grade ore and to recover the copper by precipitation. If trial heaps prove satisfactory, a new precipation plant will be constructed and provisions for leaching much of that ore will be made. A. W. Hudson, of the Copper Queen metallurgical staff, is in charge of this work.

United Verde Will Blow In Additional Furnace

Charles W. Clark, managing director for United Verde Copper Co., in recently outlining plans for his company's property, stated that the early blowing in of another furnace at the smelter is probable. He said that it would be the policy of the company to increase production as rapidly as possible. It is now possible to increase the output of the mine, but the added output cannot be cared for until the new crushing plant is completed.

Arizona Globe Copper Co. Resumes

The Arizona Globe Copper Co. is resuming development at its property, which is located about nine miles from Miami and near the Gibson mine. This group of claims was formerly known as the Cole-Goodwin property and was owned by the Cole Development Co. There is a shaft 530 ft. deep at the mine and much high-grade copper ore was shipped from there to the International smelter during developments previous to the depression which the industry experienced just after the war. Arthur C. Cole is a director of the new company, P. J. Hickey is president and P. J. Hickey, Jr., is superintendent in charge of operations at the mine. It is planned to sink the shaft 200 ft. deeper, after necessary repairs have been completed and surface equipment has been put in shape. One of the problems in connection with the development of this property is its inaccessibility, but it is expected that the county will aid in building a road from the mines to some point on the Miami-Superior highway.

IDAHO

Miners at Snowstorm Want $5.50 Per Shift

At the Snowstorm Silver Lead mine, which is situated near the Montana-Idaho state line, near Troy, Mont., eighty miners struck recently. The wages were raised to $4.25 for muckers and $5 for miners, an increase of 50c. per shift, two days before the strike. The mill was not affected, and mine and mill are still operating according to reports from the mine. The strike was for higher wages. The Snowstorm company recently added the Montana Morning property to its holdings after a reorganization. A plan for careful development of the newly acquired ground is being prepared for the coming year.

Caledonia Mine Exhausted

Prolonged efforts to find a new orebody in the Caledonia mine, near Kellogg, have proved unsuccessful, and in his report for the year 1922, Stanly A. Easton, president, holds out no encouragement in this respect. Production during the year was limited to old stope fillings, which yielded a little profit. There is sufficient of this material to cover the expense of development during the present year.

The financial statement shows that the company has a cash surplus of $315,266. This is being held pending the adjustment of federal income and net profits tax, and when this has been accomplished the remaining assets of the company will be disbursed in a final dividend. Since 1914 Caledonia has paid $4,382,868 in dividends. The last was paid in 1921. The peak was reached in 1917, when the company paid $837,800.

NEVADA

New Orebodies at Candelaria

New orebodies are being opened up in Candelaria. In the Northern Belle mine a raise from the 1,400 level has entered an orebody which averages 100 oz. silver across 3 ft. Another raise from the same level has cut 4 ft. of ore which averages better than 50 oz. silver per ton. As this latter strike is in virgin ground, possibilities are good for important ore developments. The mill is operating satisfactorily, with even better extraction than expected, and no trouble is anticipated in keeping up the present rate of production for several years.

Tonopah Bullion Production

From two weeks' operation the Tonopah Belmont shipped bullion valued at $77,600, the Tonopah Extension $81,000, the West End $68,500, and the Tonopah Mining Co. $50,000. The West End, in addition to supplying tonnage for its own mill, is shipping 40 tons daily to the mill of the Tonopah Mining Co. at Millers.

Halifax Ships to West End Mill

The Halifax company, at Tonopah, reports the finding of the faulted segment of its main vein, which is generally regarded as the easterly extension of the Belmont vein, between the 1,000 and 900 levels. The raise on the vein shows a full face of high-grade ore. The Halifax is shipping 40 tons of ore daily to the West End mill, grade being considerably above that of average Tonopah ore.

Tolicha District Will Be Developed

There is a revival of interest in the Tolicha district, about 35 miles south of Goldfield, and considerable surface work is being accomplished. Several years ago the Goldfield Consolidated had an option on what is regarded as the most promising property of the district, but relinquished the option after driving a crosscut tunnel 100 ft. long and doing other work. Since then the district had been neglected until Charles E. Knox, of the Montana Tonopah, and associates took an option on about the same ground and started to dig. Others have started work on adjoining and near-by claims, and possibilities are regarded as good. Values are principally in gold. The mineralized zone can be traced for about three miles, with spots showing good values for the entire distance. Tonopah and Goldfield people are heavily interested.

Pioche Shipments

Shipments average more than 2,000 tons per week from the Pioche district. Leases of property in camps tributary to Pioche are again in demand. The Stella mines has been taken over by R. R. Evans and associates, of Salt Lake City. This property, which consists of three claims, has been a steady producer for the past six years, and dividends have been paid every year to the owners of the ground.

MONTANA

Anaconda Produces Cadmium, at Great Falls

The Anaconda Copper Mining Co. is now producing approximately 500 lb. of cadmium per day at the electrolytic plant at Great Falls. It is really a by-product of the zinc plant, and is obtained from the zinc ores mined in Butte. Its presence in the Butte ores has been known for a long time, but only recently has there been any attempt to recover it on a commercial scale. Its present market value is said to be $1.25 per pound.

Cadmium is a metal that has the property of lowering the melting point of certain other metals. In appearance it resembles zinc, but has a bluer tinge.

The presence of cadmium in the zinc detracts from the value of the latter metal. As now refined Anaconda zinc contains only 0.05 per cent of cadmium, and is recognized as almost chemically pure.

Butte Mines "Healthy," Says Insurance Man

A. D. Reiley, chief underwriter for the Mutual Life Insurance Co., with headquarters in New York City, has just finished an extensive underground inspection of mines in the Butte district. He was highly complimentary of the interest taken in accident prevention. He said that he had particularly noticed the enthusiasm on the part of the operators toward making all working places as safe as possible for their employees. "The mines of Butte are as healthy as any I have ever seen," he declared.

Capacity of Fertilizer Plant to Be Doubled

Work was started by the Anaconda company on March 19 to enlarge the fertilizer plant at Great Falls. The construction work will be under the supervision of W. C. Capron, mechanical superintendent. The old leaching plant building will be remodeled. Work on the fertilizer unit proper will require many carpenters, sheet-metal workers, masons, and other craftsmen, and will call for an expenditure of approximately $400,000. It will be completed some time in September of this year.

The present plant has a capacity of 120,000 lb. per day. When the new unit has been completed the whole plant will have a capacity of 300,000 lb. The present production will not nearly meet the demand for the product.

Receiver for Boston & Montana

The Boston & Montana Mining & Power Co. filed its annual report on March 15, showing the capital stock to be $500,000, all of which has been paid in the purchase of the property. The bonded indebtedness amounts to $500,000 and accounts payable are $172,192.29. The directors are W. R. Allen, John Pope, E. E. Essylstyn, and O. L. Heater. C. S. Muffly, president of the Montana Mining Association, has been named as receiver for the corporation.

WASHINGTON

Small Mill for Consolidated Silver Mountain

W. F. Seelye, manager of the Consolidated Silver Mountain Mining Co., operating and developing a mine 26 miles east of Addy, reports that the crosscut tunnel has reached the ore encountered in diamond-drilling operations last winter. The ore is high grade, but has not been penetrated far enough to determine its width. The drill passed through 14 ft. of ore at a point about 60 ft. from where the recent strike was made. The company expects to erect a small concentrator this summer.

UTAH

Better Housing for Employees at Bingham

The camp of Bingham has returned to the activity of the pre-war and war periods. Housing conditions are now about normal. Houses owned by the large mining companies have been brought into good repair, following the deterioration of the period of idleness, and private owners are rapidly bringing their properties into good condition. A special effort is being made by the various mining companies to furnish suitable accommodation for all of those coming to the camp to seek employment. In general, there is not an acute shortage of skilled labor, but the demand for common labor of all classes is still strong, and the large operators especially could use more of this class of labor. In regard to the kind of labor available, this is said to be superior to that which was to be had at the time of the suspension of copper production in 1921. Under the recent wage increase, the pay for common labor ranges from $3.35 to $4.75 a day. Machine men are receiving $5.25 a day, and helpers, $5. Hand miners under the increase are being paid $5 day, and open-cut miners from $4.50 to $5.25. Timber men get $5.25 and mechanics from $5.50 to $5.75 a day.

Output of Utah Camps

The total production of Park City for the week ended March 22 amounted to 5,468 tons of ore and concentrate. Shippers were: Park-Utah, 2,392 tons; Park City Mining & Smelting, 1,162; Silver King Coalition, 1,376; Ontario, 400; Keystone, 138 tons.

Shipments from Bingham (exclusive of Utah Copper & Utah Consolidated) totaled 108 cars for the week. Shippers were: United States, 66 cars; Utah-Apex, 23; Bingham Mines, 10; Montana-Bingham, 9.

JOPLIN-MIAMI DISTRICT

New Mill Near Joplin

The Joe Bob Mining Co. has completed the erection of a small concentrator on its lease on the A. Z. L. & S. Co.'s land adjoining the city limits of Joplin on the northeast. The Joe Bob Co. took a lease on the tract last December and installed a Layner "Texas" 10-in. pump for dewatering. After the land was drained developments encouraged the company to proceed with the erection of the mill. Gas engines are used for power.

Schwab Representatives Establish Headquarters

W. H. Lohman, general manager and engineer for the Charles M. Schwab interests in this district, with E. D. Ballard, field representatives for the company, have established headquarters at Miami. Mr. Lohman states the dewatering of the tracts near Quapaw, recently obtained through the Indian Department, will be started about April 15.

Montreal Concentrator Being Moved

The old Montreal concentrator, operated since 1915 in Douthat, Okla., over one of the richest mines the district has known, is being moved and reconstructed on what is known as the Montreal No. 2 tract, situated near the Chubb mine, northwest of Picher. Few changes will be made in the plant, gas engines being used for power as at the Montreal. However, the belt conveyor method of disposing of tailings will be used, as at the Golden Rod M. & S. Co.'s property. Two shafts have been put down on the Montreal No. 2 tract, but the ground is not yet opened up.

MICHIGAN

Decreased Manufacturing May Help Mines by Supplying Needed Labor

If the predicted slowing down of manufacturing in Michigan takes place, as announced by John L. Lovett, secretary-manager of the Michigan Manufacturers' Association, it is believed many men will return to the Michigan copper district to take jobs in the mines.

July 1 is the date set by most industrial concerns for the beginning of the slowing down process, according to Mr. Lovett. High wages now being paid workers will be the cause of the expected depression, he declares. Various employers are bidding against each other daily for men. This is having a tendency to send wages still higher. The end will come, business men believe, when curtailment sets in and the business pendulum swings the other way. High wages, says Mr. Lovett, increase wholesale costs, and increased prices for commodities will not be borne for any length of time by the people of the country as a whole. This, in effect, will bring on a "buyers' strike," and orders will be cancelled.

No matter what the extent of the predicted depression in Michigan industrial centers, the mines of the Michigan copper district will be in a position to absorb all the labor which may come northward, mine managers declare. Underground forces are so far from adequate that there is room for several thousand men. It is not expected that copper will drop below 17c. per lb. and if this level or better is maintained, the mines will be ready to recruit their working forces up to somewhere near normal requirements.

Situation at the Mines

By Arthur B. Parsons
Assistant Editor

EVEN with new wage scales averaging only about 40c. below the maximum reached during the war, metal-mining operations throughout the country are governed by the ability to get miners to produce at the rate that is desired. Copper production especially is restricted. During March an increase of approximately 50c. per shift was put into effect in the following localities: Michigan Copper country; Butte, Anaconda, and Helena in Montana; the Coeur d'Alene region in Idaho; Bingham, Tintic, and Park City in Utah; Ely, in Nevada; all of the Arizona copper districts; Lordsburg and Santa Rita, in New Mexico; and at the El Paso smelter, in Texas. Wages of miners in the Picher zinc-lead district of Oklahoma and in the lead mines of Southeastern Missouri were advanced 25c. The present rates and comparative figures for other dates are shown in the accompanying table.

Representative Wage Scales for Miners

District	Jan., 1914	Nov., 1918	Jan. 1, 1922	Dec. 1, 1922	March 1923
Globe-Miami, Ariz.	$3.75	$6.15	$4.50	$4.95	$5.45
Randsburg, Cal.	....	6.25	6.25	6.25	6.25
Cripple Creek, Colo.	4.00	5.00	4.50	4.75	4.75
Coeur d'Alene, Idaho	3.50	5.75	4.25	5.00	5.50
Copper Country, Mich.	2.93	5.50	3.15	3.50	4.20
Mesabi Range, Minn.	....	6.32	3.50	4.00	4.16
Butte, Mont.	3.50	5.75	4.75	4.75	5.25
Tonopah, Nev.	4.50	6.00	5.25	5.75	5.75
Picher, Okla.	....	4.50	3.50	4.00	4.25
Park City, Utah	3.25	5.25	4.25	4.75	5.25
Porcupine, Ont.	3.50	5.28	5.28	4.80	4.80
Price of lead, cents	3.86	8.50	4.70	7.63	8.25
Price of zinc, cents	5.06	8.45	4.69	6.81	7.75
Price of copper, cents	13.60	26.00	13.46	14.51	17.00
Dun's Commodity Index	124.53	230.53	164.44	185.63	191.15

An advance had been expected for about May 1, at which time the annual exodus from the mines to scenes of various kinds of outdoor work begins. However, the Michigan copper producers, probably planning to gain a tactical advantage by making the increase ahead of schedule, announced a 20 per cent raise from $3.50 to $4.20 early in the month; but so keen is the competition for experienced mine workers all over the West, that hurried conferences were held, and by March 15 virtually every miner in the country found himself earning 50c. more per day.

In the Coeur d'Alene it was asserted that the increased scale was the consequence of the high price of lead. In a sense this is true, because if the lead market were not good there would not be a strong incentive for maximum production; but the immediate reason is the action of the copper-mining companies in Butte in boosting their scale. The comparatively low railroad fare between Butte and Coeur d'Alene promotes a flow of workers between the two places. In a few instances it was intimated that the wage increase might be attributed to an altruistic desire on the part of the companies to share with the employees the prosperity that accompanies 17c. copper, 8.25c. lead, and 8c. zinc. Generally, however, it was admitted frankly that the purpose was to induce the men by the most direct means possible to stay on the job; and to attract others if possible. Few managers express themselves as being optimistic of any material increase in the supply of workers as a consequence of the wage advance; in fact, most will be satisfied if they can hold the forces that they have. Generally speaking, lead, zinc, silver, and gold mines lack only a little of being adequately manned, but this is not so of copper mines, particularly in Michigan and to a less extent in Arizona. Faced with the seeming impossibility of getting more men, effort is being directed more than ever to the introduction and development of mechanical devices and the improvement of methods, to the end that production per man-shift may be increased.

Illustrative of this tendency is the decision of the Utah Copper Co. to equip all of its steam shovels with caterpillar tractors so as to eliminate the standard-gage track on which the shovels hitherto have run. Two shovels with the new equipment have operated for several months and have proved satisfactory, saving a track-shifting crew of four men for each shovel.

Silver-mining activity is inversely proportional to the length of time before the Pittman Act repurchases shall have been completed. It gains in momentum as that time approaches. The announcement by the Director of the Mint on April 30 that the purchases will probably be completed by July 1 is startling news to producers, who had anticipated a $1 silver market until Oct. 1. At Phillipsburg, Mont., lessees have been directed to "clean-up" and ship all ore at once; Tombstone, Ariz., is far busier than it has been for twenty years, because of the feverish activity in getting high-grade silver ore to the smelter; and at Duncan, another Arizona camp, mill construction has been suspended so that energy can be concentrated on the shipping of silver ore. The Tonopah Extension has just completed in record time the installation of equipment to increase the capacity of its mill from 425 to 500 tons, and in Utah records are being broken in the shipment of dry silver ores from Tintic and Park City.

In connection with the accompanying table it may be explained that in many of the districts contract or bonus schemes of payment are in vogue, whereby the average earnings of miners have been materially higher than even the new wage scale. However, almost invariably, an increase in the day's pay wage soon reflects itself in the readjustment of contract rates or bonus bases, so that increased earnings for all employees will result.

Supplementing the wage data are some figures showing the comparative prices of the metals and also Dun's commodity index number for different dates. The steady increase in that significant figure illuminates, or is illuminated by, the wage scales.

In California, the Great Western Chemical Co. is completing a plant for the treatment of its ore by preferential flotation. Wages have not been raised. So far, none of the mines in Washington and Oregon have followed the lead of the Coeur d'Alene operators, with whom they must compete for labor, in raising wages. In the Coeur d'Alene a marked increase in ore shipments was reported for March; the Bunker Hill smelter is operating two furnaces producing 3,500 tons of lead per month. In Butte the labor situation is not critical, but the coming of spring is the cause of some apprehension.

The Phelps Dodge Corporation plans to start the smelter at Clifton, Ariz., about April 30, and has already blown in an additional furnace at the Douglas plant. Concentrates from the new Bisbee flotation plant, just started, and from the Moctezuma mill, at Nacozari, will supply the Douglas smelter at capacity—about 12,000,000 lb. per month.

At Ely, Nev., the Nevada Consolidated is increasing production rapidly and the Consolidated Coppermines Co. is adding men to its payroll steadily. Preliminary work for the mining of lead ore is under way at Hamilton, Ward, and Eureka. Tonopah production is normal.

Shipments of concentrate from the Joplin-Miami zinc-lead fields during the first twelve weeks of the year exceeded those of the first six months of 1922. A large part of this was from stockpiles, which are steadily being reduced.

Production of copper in Michigan during March totaled 12,100,000 lb., about 55 per cent of "normal." Metal is sold as fast as smelted, instead of piling up on the docks, as is usual in the winter. Little construction work is being done.

Scarcity of labor is retarding operations on the Lake Superior iron ranges.

Power shortage seriously cripples operations at Porcupine. The nickel industry around Sudbury is improving.

The appearance of the Premier company's annual report, in which the diminution of the grade of the ore below the third level is revealed has somewhat damped the ardor of neighboring operators, and probably that of some London speculators.

THE MARKET REPORT

Daily Prices of Metals

Mar.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
29	17.00	46.00	48.00	8.25	8.15@8.175	7.55@7.65
30	17.00	46.00	48.00	8.25	8.15@8.175	7.55@7.65
31	17.00	46.00	48.00	8.25	8.15@8.175	7.55@7.65
Apr. 2	16.75@17.125	46.00	47.875	8.20@8.25	8 175	7.50@7.60
3	16.75@17.125	45.75	47.625	8.20@8.25	8.175	7.50@7.60
4	16.75@17.125	44.75	46.75	8.20@8.25	8.175	7.45@7.55

*These prices correspond to the following quotations for copper delivered: March 29th to 31st inc., 17.25c.; April 2d to 4th inc., 17@17.375c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

March	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
29	74⅞	75¾	82½	219	219½	28¼	28¼	36⅜	36¼
30	...	...	...	...	....	...	...	...	...
Apr. 2	...	...	...	...	....	...	...	...	...
3	75½	76¼	83	219	219¾	28¼	28¼	36½	36
4	74⅞	75⅝	83	214	214½	28¼	28¼	35⅝	35¾

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver			Apr.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
29	4.68⅛	99⅜	68⅜	32¾	2	4 67⅝	99⅜	68¼	...
30	4.67¾	99⅜	68⅜	...	3	4 66½	99⅜	68⅛	32 13/16
31	4.67½	99⅜	68⅜	...	4	4.66⅜	99⅜	67½	32 9/16

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for March

Copper:	
New York Electrolytic	16.832
London Standard	73.851
London Electrolytic	81.464
Lead:	
New York	8.252
St. Louis	8.254
London	28.815
Silver:	
New York, foreign	67.556
New York, domestic	99.625
London	32.310
Sterling Exchange	469.269
Zinc:	
St. Louis	7.706
London	36.720
Tin:	
99 per cent	46.569
Straits	48.569
London	219.607
Antimony	8.885
Quicksilver	70.808
Platinum	110.846

Metal Markets

New York, April 4, 1923

Copper

Most producers continue to quote copper at 17⅜c. delivered, but report only occasional orders for small tonnages at that level. Copper is obtainable at 17.25c. in two or three directions, but at that price, also, the volume of business has been small. Some forward copper has also been sold at a considerable discount from this price, and consumers near New York where the freight rate is low have also been able to do better than 17.25c. delivered. There is as yet no evidence of a buying movement, but it is thought that this cannot be postponed much longer, and few breaks in the ranks of producers holding for 17⅜c. are expected. The export demand has also been weak.

Lead

The official contract price of the American Smelting & Refining Co. continues at 8.25c. New York.

April and May lead have been freely offered at 8.25c. all week in the New York market, and beginning on Monday substantial tonnages of foreign lead were sold at 8.20c. This is a direct result of the London market, the weakness in lead there, accompanied by a fall in sterling, allowing a profit to be made on the sale of lead here at 8.20c.

The St. Louis market has been more or less variable, with dealers having a much more exalted idea of the price than consumers. One sale of lead was made as low as 8⅛c. last Thursday. Over the week-end the market improved somewhat, and yesterday a dealer was reported to have been unable to obtain lead at 8.20c., though consumers were able to buy at that price, and at 2½ points lower.

Zinc

Galvanizers have been practically out of the market again, and zinc sales have been few. There is somewhat less discrepancy in the prices asked for spot and forward, the prompt price coming nearer to that which was asked for forward a week or two ago. April zinc was reported offered today at 7.50c. New York prices are 35c. per 100 lb. above those at St. Louis. High-grade zinc continues at 8.75@9.00c. delivered in the East.

Tin

The tin market has been entirely lifeless, with practically no sales on Friday, Saturday, and Monday. The New York price has ruled below the import cost. Chinese offerings continue to depress the price of 99 per cent grades. Forward deliveries of Straits have been quoted at the same prices as have been asked for spot.

Arrivals of tin, in long tons: Total for March, 8,647; April 2d, Liverpool, 75; Straits, 425; China, 115; London, 75; 3d, London, 75; Java, 375.

Gold

Gold in London: March 29, 88s.; April 3, 88s. 1d.; April 4, 88s. 6d.

Foreign Exchange

On Tuesday, April 3, cable quotations on francs were 6.565c.; lire, 4.93c.; marks, 0.0048c.; and Canadian dollars, 1¾ per cent discount.

Silver

The market has been quiet during the Easter holidays, and subsequently declined somewhat on account of sales from China. This easier tendency may have been caused by the announcement on March 31 by the Director of the Mint reported on p. 636.

Mexican Dollars—March 29th, 52⅜; 30th, 52⅜; 31st, 52⅜; April 2d, 52¼; 3d, 52; 4th, 51½.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—General market for 99 per cent grade, 25½@26c. per lb.; 98 per cent, 24½@25c. London quotations, £92@£105.

Antimony — Chinese and Japanese brands, 9c. W. C. C., 9¼c. Cookson's "C" grade, spot, 10⅜@10⅝c. Chinese needle antimony, lump, nominal, 5¼@5½c. per lb. Standard powdered needle antimony (200 mesh), 5½@6c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6⅞@7⅛c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium — $1.10 per lb. London quotes 5s. 6d.

Cobalt—Metal, $2.65@$2.85 per lb.; black oxide, $2 per lb. in bbls. London 11 to 12s. for metal; black oxide, 9s.

Iridium—$260@$275 per oz.

Magnesium—Sticks, 1⅛ in., 99.9 per cent, $1.25 per lb. London quotes 4s.@4s. 9d. for 99 per cent.

Molybdenum Metal—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage. Metal powder, 96@98 per cent, $3.50@$4 per lb.

Monel Metal — Shot, 32c.; blocks, 32c. per lb., f.o.b. Bayonne, N. J.

Nickel—25@30c. per lb. for 99 per cent virgin metal.

Osmium—Pure, $75@$80 per oz. troy, in Los Angeles. Strong.

Palladium—$79 per oz. London, sponge, £11@£12 10s.

Platinum—$115 per oz. London, £23.

Quicksilver—$70 per 75-lb. flask. San Francisco wires $70.20. London, £12.

Radium—$70 per mg. radium content.

[1]**Rhodium**—$4.50@$5 per gram.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.10 per lb.

[1]**Tellurium**—$3 per lb. in 10-lb. lots.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $4 per lb. in 25-lb. lots.

Tungsten Metal—Powder, 97 to 98 per cent, $1 per lb. contained tungsten.

Metallic Ores

Chrome Ore—Indian chrome ore, $20.50 per ton, c.i.f. Atlantic ports. Rhodesian and New Caledonian, $21@$24.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5 per long ton; old bed concentrates, 63 per cent, $5.25; Harmony, cobbed, 63 per cent, $5.25; new bed low phosphorus, 65 per cent, $7.50.

Manganese Ore—40@45c. per long ton unit, seaport, plus duty; chemical ore, $75@$80 per gross ton.

Molybdenum Ore—75@85c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates, plus duty.

Tantalum Ore—Hand-sorted ore, 70 per cent combined columbite-tantalite, 40c. per lb., South Dakota.

[1]**Titanium Ores**—Ilmenite, 52 per cent TiO_2, ¾@1c. per lb. for ore. Rutile, 96 per cent TiO_2, 10c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore — Wolframite, $8; scheelite, $8.50@$9 per unit of WO_3.

Uranium Ore (Carnotite)—Ore containing from 2 to 2½ per cent U_3O_8, $3.50 per lb. of contained U_3O_8.

Vanadium Ore—No quotation. Recently $1 per lb. of V_2O_5 content.

Zircon—$50 per ton.

Zinc and Lead Ore Markets

Joplin, Mo., March 31—Zinc blende, per ton, high, $50.10; basis, 60 per cent zinc, premium, $49@$48.50; Prime Western, $47.50; fines and slimes, $46@$43; average, all blende, $48.21. Calamine, basis 40 per cent zinc, $28@$30; average settling price, $32.21.

Lead, high, $119.35; basis, 80 per cent lead, $115; average settling price, $117.92 per ton.

Shipments for the week: Blende, 15,473; calamine, 56; lead, 2,214 tons. Value, all ores the week, $1,008,910.

Shipments for three months: Blende, 192,481, calamine, 1,391; lead, 23,414 tons. Value, all ores three months, $11,091,200.

Buyers made scant offerings on the declining slab zinc market, and only 12,000 tons was purchased, 3,470 less than the shipment. Buyers of lead were active and increased the tonnage, on a declining market, nearly 600 tons.

Platteville, Wis., March 31.—Blende, basis 60 per cent zinc, $51 per ton. Lead, basis 80 per cent lead, $123 per ton. Shipments for the week: Blende, 216 tons; lead, none. Shipments for the year: Blende, 8,627; lead, 145 tons. Shipments for the week to separating plants, 356 tons blende.

Non-Metallic Minerals

Asbestos.—Crude No. 1, $500; No. 2, $250@$325; long spinning fibers, $135@$200; magnesia and compressed sheet fiber, $100@$150; shingle stock, $65@$85; paper stock, $35@$42; cement stock, $20@$25; shorts, $9@$14—all per short ton, f.o.b. mines, Quebec, Canada.

Rhodesian No. 1 crude, $375; No. 2, $250; inferior grade, $200—all c.i.f. Atlantic ports per short ton.

Barytes — Crude, $8@$10 per ton; white, dry ground, $16@$18; white, wet ground, $22@$25 per ton; off color, dry ground, $13@$15; off color, wet ground, $15@$16, f.o.b. plant.

Bauxite—American, crushed and dried, $6@$9 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, $22@$25 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at $5@$8 per metric ton, c.i.f. Atlantic ports, depending upon grade.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 5¼c. per lb.; in bbls., 5½c. Boric acid, 11c.

Chalk—English, extra light, 5c. Domestic light, 4½@4¾c.; heavy, 3½@3¾c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $7@$9; washed, $8@$9; powdered, $13@$20, f.o.b. Virginia points. Imported mines, Georgia; powdered clay, $14@$20, f.o.b. Virginia points. Imported lump, $15@$20, f.o.b. American ports; powdered, $45@$50, f.o.b., New York. 1A grade, refined, $15 per ton, Delaware.

Canadian, in lumps, $16@$18, f.o.b. Quebec points. Demand good.

Diatomaceous Earth — Crude, air-dried material, in large lumps, $8 per ton, f.o.b. California quarries. Ground material for insulation is priced according to density. It is being sold for $35 per ton, having a settled weight of 15 lb. per cu.ft., and $25 per ton for 20 lb. per cu.ft. The highest grade of material, the so-called "air float" or "baghouse," suitable for polishes and similar uses, brings from $75 to $100 a ton. All prices f.o.b. quarry. Contracts with large consumers are at present in force at a figure as low as $17 per ton, f.o.b. quarries, for filter material. All above quotations are on a minimum car basis, a minimum car holding 20 tons of 2,000 lb.

Emery—Turkish and Greek, 6@8c. per lb. American, 3½@5½c. Inferior grades, 3½c., f.o.b. New England points.

Feldspar — No. 1 pottery grade, $6@$7.50 per long ton; No. 2, $5@$5.50; f.o.b. North Carolina points. No. 1, $7.50; No. 2, $6.50; ground, 60 to 80 mesh, $18@$20 per short ton; 120 to 150 mesh, $20@$24; 200 mesh, $25@$30, f.o.b. Connecticut points. No. 1, Canadian, 120 mesh, $20 per net tons, f.o.b. Ohio mills. No. 1 crude, $6 per ton, f.o.b. Maine mines.

First quality ground, $19 in New Hampshire, $18 in Maine; second quality, $16 in New Hampshire. In Colorado, No. 1 crude, $5; No. 2, $4.50 per short ton.

Fluorspar — Fluxing gravel, 85 per cent CaF_2 and not over 5 per cent silica, $21.50, f.o.b. mines; not over 6 per cent silica, $21; 80 per cent grade, not over 5 per cent silica, $20; ground acid grade, $45 in bulk; ground enamel-

[1]Price furnished by Foote Mineral Co., Philadelphia, Pa.

ing grade, $35 in bulk; packages, $4 extra, all f.o.b. mines, Illinois.

Gravel with limestone gangue, $14; lump, 92 per cent CaF_2, $17, f.o.b. New Mexico.

No. 1 lump, $30; No. 2, lump, $25, f.o.b. Illinois mines.

Fuller's Earth—16 to 60 mesh, $18 per ton; 16 to 30 mesh, $17; 30 to 60 mesh, $18; 60 to 100 mesh, $14; 100 mesh and finer, $7.50; f.o.b. Florida mines.

Graphite—American flake, 4@5c. per lb. at mines. Ceylon lump, first quality, 6@6½c. per lb.; chip, 5@5½c.; dust, 4@4½c. Mexican crude amorphous, $15@$35 per ton, f.o.b. New York. Flake graphite, 10@30c. per lb.; foundry grades, 4@7c.; boiler, 8@14c.; lubricating, 10@50c. per lb.

Gypsum—Crushed rock, $3 per ton in most states. Ground, $3.50@$4, f.o.b. shipping points.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ½ in. and larger, $1.10 @$1.35 per net ton. Agricultural limestone, $2.50@$3 per net ton, f.o.b. eastern shipping points.

Magnesite — Dead-burned magnesite grains, $40 per net ton, f.o.b. Baltimore; $40@$42, Chester, Pa.

Crude, $14 per ton; 85 to 90 per cent MgO calcined lump, $32.50@$38 per ton; calcined ground, in paper sacks, 90 per cent through 200 mesh, $44@$48 per ton—all f.o.b. California points.

Grecian caustic-calcined and ground, $51@$52 per ton, f.o.b. cars, Atlantic seaboard.

Dead-burned magnesite in bulk, $32 @$34 per net ton, Washington points.

Manjak—Barbados, in 1 to 5 ton lots, grade "C" lump, $330 per short ton; "C" fine, $250; grade "A," $185—all c.i.f. New York.

Mica—Domestic, No. 1 quality, 1½x2 in., 15c. per lb.; 2x2 in., 35c.; 2x3 in., 80c.; 3x3 in., $1.20; 3x4 in., $1.60; 3x5 in., $2; 4x6 in., $2.80; 6x6 in., $3.60, all per lb., f.o.b. North Carolina, thumb trimmed; 1½ in. disks, 75c. per lb. No. 2 stove mica: punch, 8c.; 2x2 in., 25c.; 2x3 in., 50c.; 3x3 in., $1; 3x4 in., $1.40; 3x5 in., $1.75; 4x6 in., $2.25; 6x8 in., $3.25. Flake, 12c. per lb. Scrap, $25 per ton. All f.o.b. Virginia points.

Scrap, $22 per short ton; washer, 8@10c. per lb.; disk, 15c. per lb., f.o.b. Connecticut points. Market active.

[1]Monazite—Minimum 6 per cent ThO_2, 6@8c. per lb.

Phosphate — 77 to 76 per cent tricalcium phosphate, hard rock, $7.50 per ton, f.o.b. Jacksonville; 77 to 76 per cent pebble grades, $6.75; 75 to 74 per cent pebble, $5.75; 70 per cent pebble, $4.35; 66 to 68 per cent pebble, $3.90, f.o.b. Tampa.

For 72 per cent washed run of mine, $5.50@$6; 75 per cent washed lump, free of fines, $6.50@$6.75; 75 per cent hand-mined lump, $6@$6.50, all per long ton, f.o.b. Tennessee points. For 65 per cent grades ground to 95 per cent through 100 mesh price is $6.50 per short ton; $7.50 per short ton for 70 per cent material.

Pumice Stone—Imported lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Imported lump, 1 in. diameter and up, 12c. per unit; furnace size, 2½ in. diameter, 12½c. per unit; fines, through ½-in. mesh, 12c. per unit; cinder property of buyer, ex ship, Atlantic ports. Ore contains 50@51 per cent sulphur; cinder about 63 per cent iron.

Silica—Glass sand, generally $2@$2.75 per ton, f.o.b. shipping point; sand-blast material, $2.50@$5. Ground, 250 to 450 mesh, $20@$40, f.o.b. mills. Glass sand, $5@$10, f.o.b. Massachusetts.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—150 to 200 mesh, $6@$8.50 per ton, Vermont. Price depends upon color as well as fineness. Paper bags, $1 per ton extra. Burlap bags, 12 to the ton, 10c. each extra, with 9c. return allowance.

In New York, 200 to 325 mesh, $14.75 per ton for air-floated talc. 300 mesh, $11.50@$14.75 per ton.

In Georgia, white, $7@$9; yellow, $8.50; red, $12.

In California, 200 mesh, $15@$20 per ton; 300 mesh, $25@$30.

Roofing talc and soapstone, $7@$8 per ton, f.o.b. mill in Vermont.

Tripoli—Once ground, rose and cream colored, $16@$25; white, $18@$27; double ground, r. and c., $17@$25; w., $19@$30; air-float, r. and c., $25@$30; w., $35; super air-float, r. and c., $35@$40; w., $40@$45. All per short ton in 200-lb. burlap bags with paper liners, minimum car, 30 tons, f.o.b. Missouri.

Mineral Products

Arsenious Oxide (white arsenic)—14@15c. per lb. for prompt, nominal. June, 12½c. 2d half 1923, 11c.

Copper Sulphate — Large crystals, 6.50c. per lb.; small, 6.40c.

Sodium Nitrate—$2.65 per 100 lb., ex vessel Atlantic ports.

Potassium Sulphate — Powder, domestic, $1 per unit, basis 90 per cent.

Sodium Sulphate—$26@$28 per ton, New York.

Ferro-Alloys

Ferrocerium—Per lb., $15@$20.

Ferrochrome—1 to 2 per cent carbon, 28@30c. per lb.; 4 to 6 per cent carbon, 12c. per lb.

Ferromanganese — Domestic, 78@82 per cent, $120 per gross ton, f.o.b., furnace. Spiegeleisen, 19@21 per cent, $40, f.o.b. furnace; 16@19 per cent, $39.

Ferromolybdenum—$2@$2.50 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $48 @$55 per gross ton, f.o.b. works; 50 per cent, $95 delivered.

[1]Price furnished by Foote Mineral Co., Philadelphia, Pa.

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — 90@95c. per lb. of contained W., f.o.b. works. Market firm.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3.50@$4 per lb. of V contained, f.o.b. works.

Metal Products

Copper Sheets—New York base, 25½c. per lb.; wire, 19⅜c. net.

Lead Sheets—Full lead sheets, 10.25c. per lb.; cut lead sheets, 10.50c. in quantity, mill lots.

Nickel Silver—31c. per lb., for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 22¾c. per lb.; rods, 19¾c. per lb.

Zinc Sheets—$10 per 100 lb., f.o.b. works.

Refractories

Bauxite Brick—$140@$145 per M Pittsburgh, Pa.

Chrome Brick—$50@$52 per net ton, f.o.b. shipping point.

Chrome Cement — $23 per net ton, f.o.b. shipping point.

Firebrick—First quality, $45@$47 per M., Ohio and Kentucky works; second quality, $41@$43.

Magnesite Brick — 9-in., straights. $65@$68 per net ton, f.o.b. works.

Magnesite Cement—$47@$50 per net ton, f.o.b. Chester, Pa.

Silica Brick $47@$49 per M., Pennsylvania; $52@$54, Indiana; $48@$50, Alabama.

[1]Zirkite—Powdered, $50@$60 per ton; brick, $100 per ton.

The Iron Trade

Pittsburgh, April 3, 1923

The turnover in the open market in finished-steel products continues to decrease, as less and less business is done in the late deliveries. The volume of prompt business appears to be increasing. Delivery premiums are larger. In sheets there is little but prompt business being done, this being at 4c. for black.

Minimum prices are up $2 a ton on bars to 2.35c. and on shapes and plates to 2.45c.

Pressure is particularly heavy for deliveries of merchant pipe and nails, and there is heavy call for automobile steel, which is not being bought far ahead.

Steel production continues at a high rate, with mills running more smoothly than for a long time. The predicted wage advance has not been made.

Pig Iron—The market has turned quiet and prices may not go any higher. Bessemer, basic, foundry and malleable are all at $31, Valley.

Connellsville Coke—Market demand is light. There has been some holiday observance and there remains a little fear of strikes. Spot coke is $7.25 for furnace and $8.25@$8.75 for foundry.

COMPANY REPORTS

Calumet & Arizona Mining Co.

Copper; Arizona

A report of the operations of the Calumet & Arizona Mining Co. for 1922 shows a net income of $1,335,235.64, according to the following income account:

Total earnings on metals	$5,781,190.49	
Income from dividends	1,263,716.00	
Interest	178,014.72	
Other income	155,770.77	
		$7,378,691.98
Expenditures		
Operating expenses	$3,436,407.97	
Salaries, office and general expenses	128,324.62	
Freight, refining and marketing	770,229.13	
State and federal taxes	497,086.10	
		$4,832,047.82
		$2,546,644.16
Less		
Depreciation	$238,877.90	
Ore depletion	924,918.45	
Outside properties	47,612.17	
		$1,211,408.52
Net income		$1,335,235.64

Balance sheet as of Dec. 31, 1922, follows:

Assets

Mining property	$29,499,491.00	
Less reserve for ore depletion	8,912,124.41	
		$20,587,366.59
Smelting plant	$3,099,079.39	
Less reserve for depreciation	1,655,103.50	
		1,443,975.89
Sulphuric acid plant	$998,909.83	
Less reserve for depreciation	454,331.17	
		544,578.66
Other construction	$809,397.35	
Less reserve for depreciation	456,000.00	
		353,397.35
Construction at 85 branch	$387,405.06	
Less reserve for depreciation	70,000.00	
		317,405.06
Investments (at cost)		8,279,055.80
Notes and accounts receivable		2,895,003.46
Supplies at mine and smelter		779,701.48
Cash		1,780,348.68
Metals on hand and in process		1,154,497.31
Items in suspense		78,726.22
Deferred charges to operations		918,011.66
		$39,132,068.16

Liabilities

Capital stock authorized	$6,500,000.00	
Less unissued stock	74,760.00	
Outstanding stock		$6,425,240.00
Notes and accounts payable		1,205,681.28
Reserve items		282,772.11
Surplus		31,218,374.77
Earned surplus, Dec. 31, 1921	$3,116,265.57	
Income year 1922	1,335,235.64	
	$4,451,501.21	
Less dividends paid in 1922	1,285,046.50	
Earned surplus, Dec. 31, 1922	$3,166,454.71	
Paid-in surplus, Dec. 31, 1922	28,051,920.06	
		$39,132,068.16

Copper on hand is estimated at 12½c. per lb. Production in the period covered by the report amounted to 30,937,170 lb. of copper, 796,574 oz. of silver, and 248,949 oz. of gold.

Victoria Copper Mining Co.

Copper; Michigan

A report of operations of Victoria Copper Mining Co. for 1922 shows no production for the year. A small amount of exploration work was performed during the year, but gave insufficient encouragement for further prospecting.

New Cornelia Copper Co.

Copper; Arizona

A report of the operations of the New Cornelia Copper Co. for 1922 shows a net deficit of $416,841.43 according to the following income account:

Income

Total earnings on metals	$3,740,081.36	
Dividends	6,000.00	
Interest	67,858.98	
Other income	8,434.85	
		$3,822,375.19
Expenditures		
Operating expenses	$1,795,984.91	
Salaries, office and general expenses	98,101.24	
Freight, refining and marketing	358,043.94	
State and federal taxes	840,153.77	
		3,092,283.86
		$730,091.33
Less		
Depreciation	$535,902.80	
Ore depletion	611,029.96	
		1,146,932.76
Net deficit		$416,841.43

Balance sheet as of Dec. 31, 1922, follows:

Assets

Mining property	$28,075,880.55	
Less reserve for ore depletion	4,291,722.03	$23,784,158.52
Construction	7,080,164.45	
Less reserve for depreciation	3,331,898.82	
		3,748,265.63
Investments (at cost)		1,433,165.89
Notes receivable		75,000.00
Accounts receivable		1,501,914.73
Cash		187,384.12
Supplies		523,824.30
Copper on hand		1,059,822.75
Deferred charges to operations		239,658.33
Items in suspense		24,883.41
		$32,578,077.68

Liabilities

Capital stock		$9,000,000.00
Accounts payable		946,883.33
Reserve items		63,922.44
Surplus		22,567,271.91
Earned surplus Dec. 31, 1921	$2,588,497.24	
Deficit year 1922	416,841.43	
	$2,171,655.81	
Less dividends paid in 1922	1,800,000.00	
Earned surplus Dec. 31, 1922	$371,655.81	
Paid-in surplus Dec. 31, 1922	22,195,616.10	
		$32,578,077.68

Copper on hand is estimated at 12½c. per lb. Production amounted to 26,612,803 lb. of copper in 1922.

Callahan Zinc-Lead Co.

Zinc, lead; Interstate, Idaho

A report of the operations of the Callahan Zinc Lead Co. for 1922 shows a deficit of $150,261, according to the following operating account

Income

Net value of shipments (six weeks' production)	Tons		
Lead concentrates	1,556	$90,622.30	
Zinc concentrates	2,728	58,507.11	
Total output	4,284	$149,129.41	
Miscellaneous income, rents and interest		19,064.71	
Total income			$168,194.12
Expenditures			
Mining, milling and royalties		$163,574.63	
General and administrative expenses		43,649.13	
Property, maintenance and development during shutdown		107,967.99	
Galena property development		3,263.12	
			318,454.87

(Account—*Continued*)

Operating deficit for the year		$150,260.75
Proceeds of treasury and unissued stock sold		2,740,224.21
		$2,591,963.46
Current surplus, Dec. 31, 1921		504,044.19
		$3,096,007.65
Deductions from current surplus during the year:		
Interest adjustment applicable to 1921	$70.00	
Patenting of claims	563.55	
Purchase of Galena Co.'s property, equipment and other assets	1,691,038.73	
Investment in Galena stock as of Dec. 31, 1921	258,844.75	
Assessments paid on Galena stock during the year	46,531.74	
Total deductions		$1,997,048.77
Current surplus at Dec. 31, 1922		$1,098,958.88

Balance sheet as of Dec. 31, 1921, is given as follows:

Current Assets

Cash		$147,101.58
Ore shipments pending settlement	$149,129.41	
Less advance payments received	19,500.00	
		129,629.41
Accounts receivable		827,224.00
Loans and accrued interest, receivable		15,000.00
Material and supplies on hand, at cost		52,559.57
Prepaid insurance		3,559.27
		$1,175,073.83

Current Liabilities

Sundry accounts payable	$76,114.95
Current surplus	$1,098,958.88
Authorized capital stock 1,000,000 shares, $10.00 par value	10,000,000.00
Issued and outstanding 662,992 shares	6,669,920.00

Metal contents of ore and concentrates produced amounted to 35,271 oz. of silver, 2,024,431 lb. of lead, and 3,210,573 lb. of zinc.

The company, formerly owning 62 per cent of the capitalization of the Galena Mining Co., has now acquired the entire properties of that company. Commercial ore has been developed on five levels, and plans have been made to prosecute a comprehensive program for the rapid development of the Galena properties, so as to place them on a production and earning basis as soon as is consistent with sound mining practice. The management is of the opinion that the newly acquired Galena properties will be a material factor in the future earning power of the company.

German Metal Business Narrowing

The paradoxical improvement of the mark currency amidst increasing political stress has brought about the inability of German manufacturers to compete with foreign rivals in the sheet, galvanizing, and engineering lines. Refineries that used to calculate wages on a sterling basis in fixing prices for future deliveries to their German and outward customers are said to have suffered heavy losses because wages are actually paid in appreciated marks, whereas the real yield of invoiced amounts has diminished. Refineries are not able to cover themselves by purchasing metal abroad, for the stuff is becoming dear. Besides, foreign bills are needed in exchange for marks in view of high wages and living costs. Thus the compass of the metal business throughout Germany is greatly narrowing, the chief point being the diminishing export orders. In some lines, such as nickel and vanadium, business is at a standstill.

Italy is beginning to build up an independent metal industry of her own while she is constructing water-power stations to attain independence from British or German fuel, with the benefits of which she became impressed during the last war. The copper consumption of Italy in creating hydro-electric power may safely be put at 4,000 metric tons monthly, besides a thousand tons or so of bessemer copper (Braden) for sulphate making and minor purposes. The developments have been, as may be stated on good authority, pushed forward by the initiative of Mr. Mussolini. Consignments of manufactured copper to Italy from Germany have become of small quantity, for Italy can in most lines manufacture more cheaply on account of a weak currency and moderate wages.

Facts for the Stockholder

XII—Nevada Consolidated Copper Co.

THE Nevada Consolidated Copper Co. was incorporated in Maine, in November, 1904, as a consolidation of the Boston & Nevada Copper Co. and the White Pine Copper Co. In 1909 and 1910, it acquired the properties of the Cumberland-Ely Copper Co., including the latter's half interest in the Nevada Northern Railway Co., the entire capital stock of which it now owns. In 1914, it acquired the property of the Steptoe Valley Smelting & Mining Co.

The property includes more than 130 mineral claims, having an aggregate area of over 1,600 acres, including holdings acquired from the Cumberland-Ely Copper Co., consisting of 48 claims having an area of 523 acres; the Copper Flat and Eureka group, 355 acres; the Ruth group, 455 acres; the Liberty group, 46 acres; the Veteran group, 14 claims; the Jupiter group, 22 claims; 12 claims near the Giroux Consolidated; 40 acres for water supply and railroad siding; and 182 acres for dumping overburden. In 1921, the company purchased additional mineral claims, aggregating about 102 acres; also an 80-acre tract, for the disposal of mill tailing.

The chief orebodies consist of chalcocite, pyrite, and chalcopyrite disseminated through a mass of monzonite porphyry. Commercial ore is found 20 to 700 ft. below the surface, and is covered by a capping of leached porphyry, for the most part barren. The three main orebodies are the Copper Flat, Ruth, and Veteran; others include the Kimberley, Ingersoll, Wedge, and Jupiter.

The main orebodies are mined from a large open pit by steam shovels. The pit is about 4,000 ft. long, 2,500 ft. wide, and 250 ft. deep. The ore is hauled to the mill and smelter, 26 miles from the mine. The Ruth orebody, about 1¼ miles from the Copper Flat deposit, is covered by capping 100 to 540 ft. thick, and is mined by underground methods. The oval-shaped ore zone is 1,200 by 1,600 ft., and 40 to 300 ft. deep. The Ruth mine is opened by two shafts about 2,500 ft. apart, 550 and 700 ft. deep respectively, and developed by about 15 miles of underground workings and several thousand feet of churn drilling. Ore reserves aggregate about 63,400,000 tons, having an average assay of 1.58 per cent copper.

Capital stock consists of 1,999,457 shares, par value $5, of which the Utah Copper Co. owns 1,000,500. There is no funded debt. At the close of 1921, current assets were $7,858,000 and current liabilities $704,000, leaving a net working capital of more than $7,000,000, compared to over $14,000,000 in 1917. Net assets applicable to capital stock amounted to about $11.25 a share.

Production in millions of pounds has been as follows during the past eight years: 62 in 1915, 91 in 1916, 82 in 1917, 76 in 1918, 44 in 1919, 48 in 1920, 9 in 1921, and 12 in 1922.

During recent years, earnings per share have been as follows: $2.41 in 1912; $1.74 in 1913, 88c. in 1914, $2.95 in 1915, $7.72 in 1916, $4.71 in 1917, $1.63 in 1918, 61c. in 1919, and $9.12 in 1920. In 1921 there was a deficit equivalent to about 82c. a share. The property was shut down in April, 1921, and resumed operations in April, 1922. For the June quarter there was a deficit of $144,415 and for the September quarter a deficit of $124,278, but in the last quarter a net profit of $417,081, equivalent to about 20c. a share.

The dividend record is as follows: 37½c. in 1909, $1.50 in 1910, $1.50 in 1911, $2 in 1912, $2 in 1913, $1.12½ in 1914, $1.50 in 1915, $3.75 in 1916, $4.15 in 1917, $3.25 in 1918, $1.50 in 1919, and 75c. in 1920. The last quarterly payment of 25c. a share was made Sept. 30, 1920.

In July, 1922, the company's mill was destroyed by fire, but reconstruction was begun promptly, and by the end of the year sufficient equipment had been installed to treat about 5,000 tons of ore per day, with an average recovery of over 80 per cent. At present the capacity of mill and smelter is about 5,000,000 lb. of copper per month.

Price range of the stock during the past ten years has been as follows: High, 34⅛ in 1916; low, 8 in 1920; closing price 15⅝, April 4, 1923.

INVESTIGATOR.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1922	1923	1922	1923	1922	1923
January	65.450	65.668	35.035	31.928	421.750	465.053
February	65.290	64.313	33.891	30.875	435.511	468.631
March	64.440	67.556	33.269	32.310	436.912	469.269
April	66.575		34.080		440.715	
May	71.154		36.023		444.106	
June	71.149		35.900		444.615	
July	70.245		35.644		444.165	
August	69.417		34.957		446.069	
September	69.515		35.305		442.800	
October	68.015		34.498		443.583	
November	65.177		32.882		447.484	
December	63.905		31.383		460.440	
Year	67.528		34.406		442.346	

New York quotations cents per ounce troy, 999 fine, foreign silver. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1922	1923	1922	1923	1922	1923
January	13.465	14.510	65.226	64.494	72.321	71.409
February	12.864	15.355	60.250	67.700	66.125	74.500
March	12.567	16.832	59.245	73.851	65.739	81.464
April	12.573		58.799		64.028	
May	13.111		61.092		66.554	
June	13.575		61.988		69.333	
July	13.654		63.137		70.321	
August	13.723		63.784		69.932	
September	13.748		63.113		70.917	
October	13.632		62.773		70.693	
November	13.598		62.795		70.216	
December	14.074		63.267		70.132	
Year	13.382		62.123		68.859	

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1922	1923	1922	1923	1922	1923
January	4.700	7.633	4.388	7.571	23.667	27.119
February	4.700	8.050	4.396	8.093	20.681	28.519
March	4.720	8.252	4.421	8.254	21 266	28.815
April	5.115		4.946		22.993	
May	5.420		5.281		24.462	
June	5.745		5.563		24.685	
July	5.729		5.447		24.869	
August	5.824		5.537		24.580	
September	6 110		5.868		24 131	
October	6.530		6 338		25.551	
November	7 047		6.868		26.199	
December	7.163		6.978		26.079	
Year	5.734		5.503		24.097	

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1922	1923	1922	1923	1922	1923
January	31.480	37.986	32.100	39.173	163 065	181.852
February	29.835	40.693	30.767	42.011	149.850	190.513
March	28.426	46.569	29 171	48.569	143 152	219.607
April	29 810		30.605		149.840	
May	30.149		30.971		150.163	
June	30.707		31.497		152.512	
July	31 025		31.733		156.149	
August	32.134		32.380		160.006	
September	32 075		32.395		160.065	
October	33.935		34.600		170.563	
November	35.911		36.734		179.341	
December	36.480		37.695		178.697	
Year	31.831		32.554		159.450	

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1922	1923	1922	1923
January	4.691	6.815	26.321	35.733
February	4.485	7.152	24.213	35.613
March	4.658	7.706	25.467	36.720
April	4.906		26.576	
May	5.110		27.304	
June	5.346		27.893	
July	5.694		29.042	
August	6.212		31.170	
September	6.548		31.750	
October	6.840		34.528	
November	7.104		38.011	
December	6.999		37.757	
Year	5.716		30.003	

St. Louis quotations, cents per pound. London, pounds sterling, per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)	
	New York		New York		New York	
	1922	1923	1922	1923	1922	1923
January	4.463	6.884	49.960	72.731	97.260	112.462
February	4.416	7.290	48.295	70.636	89.545	113.273
March	4.319	8.885	50.204	70.808	87.500	110.846
April	4.980		52.280		87.500	
May	5.467		54.885		85.529	
June	5.145		55.115		87.212	
July	5.091		55.000		90.180	
August	5.315		57.593		98.370	
September	6.580		67.640		117.280	
October	6.905		72.560		109.440	
November	6.584		71.521		108.000	
December	6.382		72.300		113.600	
Year	5.471		58.946		97.618	

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1922	1923	1922	1923	1922	1923
January	21.55	29.27	20.15	27.35	21.34	28.77
February	21.46	29.79	19.71	28.15	20.88	27.21
March	21.35	32.03	19.96	31.79	20.83	31.77
April	22.50		21.26		22.70	
May	26.36		26.87		25.96	
June	26.96		26.96		25.96	
July	26.77		26.33		25.97	
August	30.44		27.18		30.81	
September	35.27		34.70		36.79	
October	35.27		31.77		33.40	
November	33.52		29.37		30.55	
December	29.87		26.34		27.69	
Year	27.61		25.88		26.91	

In dollars per long ton.

Monthly Crude Copper Production

	1922		1923	
	November	December	January	February
Alaska shipments	8,959,037	7,937,421	4,698,184	7,975,434
Washoe Smelter	15,500,000	15,250,000	16,250,000	15,600,000
Calumet & Arizona	3,298,000	3,582,000	3,738,000	2,998,000
Calumet & Hecla	(c)	(c)	(c)	(c)
Other Lake Superior	(c)	(c)	(c)	(c)
Chino	3,805,106	4,941,272	(c)	(c)
East Butte	(c)	(c)	(c)	(c)
Inspiration	(c)	(c)	(c)	(c)
Miami	5,636,000	5,336,447	5,679,000	5,059,000
Nevada Cons.	2,695,125	2,832,181	(c)	(c)
New Cornelia	3,178,556	3,256,547	3,034,000	2,666,557
Old Dominion	2,934,000	2,150,000	2,250,000	2,098,000
Phelps Dodge	9,890,060	6,697,000	7,783,000	7,329,000
Ray	4,074,418	4,670,692	4,670,692	(c)
Shattuck Arizona	(c)	(c)	(c)	(c)
Southwest Metals Co.	1,020,000	1,075,000	971,180	.....
United Verde	(c)	(c)	(c)	(c)
United Verde Extension	3,670,206	3,026,334	3,083,500	3,220,306
Utah Copper	10,212,046	12,464,365	(c)	(c)
Others, estimated	11,900,000	10,000,000	10,500,000	11,500,000
Total United States	.....	.....	.....	.....
Imports: Ore and concentrates, matte	19,718,401	.....	.....	.....
Imports of black and blister, unrefined	44,662,154	.....	.....	.....
Imports of refined and old	11,224,150	.....	.....	.....
Grand total	.....	.....	.....	.....
Backus & Johnston	(c)	(c)	(c)	(c)
Boleo	1,128,409	1,389,150	1,280,554	.....
Cananea	(c)	(c)	(c)	(c)
Cerro de Pasco	(c)	(c)	(c)	(c)
Chile	(c)	(c)	(c)	(c)
Cons. M. & S. of Canada	(a)	(a)	(a)	(a)
Falcon Mines	558,000	.....	582,000	567,200
Furukawa	2,878,405	.....	.....	.....
Granby Cons.	3,975,000	3,266,200	3,586,661	3,589,377
Hampden Cloncurry	(c)	.....	.....	.....
Katanga	8,330,500	10,050,370	9,223,515	7,829,955
Mount Morgan	840,000	.....	.....	.....
Mount Lyell	962,000	.....	.....	.....
Phelps Dodge Mexican	3,533,000	2,558,000	2,850,000	3,118,000
Sumitomo	3,184,772	.....	.....	1,377,643
Wallaroo & Moonta	(a)	486,343	354,372	.....

Comparative Annual Copper Production

	1919	1920	1921	1922
January	135,733,511	121,903,744	90,596,597	32,010,292
February	111,649,512	117,540,000	86,682,941	45,957,530
March	102,040,460	120,309,316	91 046,345	55,705,760
April	98,808,998	116,078,871	46,946,523 (b)	76,601,000
May	92,652 975	114,964,207	25,310,511 (b)	88,714,000
June	95,856,570	116,107,856	24,623,693 (b)	93,740,000
July	100,369,247	109,729,610	22,033,739 (b)	91,000,000
August	107,994,040	112,460,254	23,248,398 (b)	101,188,000
September	108,703,075	104,919,562	23,855,316 (b)	96,408,000
October	115,143,143	105,231,571	23,231,572 (b)	103,273,000
November	117,289,735	106,700,178	28,341,442	.....
December	102,997,633	95,709,009	29,629,137	.....

(a) No copper produced during this month. (b) Department of Commerce. (c) Not available.

MINING STOCKS

Week Ended March 31, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	81	80	80½	Mar. 23, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	2¼	2¼	2¼		
Allouez	Boston	28	26½	27	Mar. '19	1.00
Anaconda	New York	51	49¼	50⅜	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3½	3	3		
Ariz. Com'l	Boston	13½	13½	13½	Oct. '18, Q	0.50
Calaveras	N. Y. Curb	3⅜	3¼	3¼		
Calumet & Arizona	Boston	62½	61¼	62	Mar. '23,	1.00
Calumet & Hecla	Boston	371	355	365	Mar. '23, Q	7.00
Canada Copper	N. Y. Curb			*4		
Centennial	Boston	12	11	12	Dec. '18, SA	1.00
Cerro de Pasco	New York	50½	46½	49½	Mar. '21, Q	0.50
Chile Copper	New York	28⅛	28⅛	28⅛	Mar. 23,	0.625
Chino	New York	29⅜	28⅜	29	Sept. '20, Q	0.37
Copper Range	Boston	44¼	42¼	44¼	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1⅛	1⅛	1⅛		
Davis-Daly	Boston	4¼	4	4	Mar. '20, Q	0.25
East Butte	Boston	10¼	10	10¼	Dec. '19, A	0.50
First National	Boston Curb	*55	*55	*55	Feb. '19, SA	0.15
Franklin	Boston	2¼	2¼	2¼		
Gadsden Copper	N. Y. Curb	*85	*85	*85		
Granby Consol.	New York	32¼	30⅛	31¼	May '19, Q	1.25
Greene-Cananea	New York	31⅛	30	30	Nov. '20, Q	0.50
Hancock	Boston	10¼	10⅛	10¼		
Howe Sound	N. Y. Curb	4¼	3⅛	3⅛	Jan. '21, Q	0.05
Inspiration Consol.	New York	39⅛	38⅛	38⅛	Oct. '20, Q	1.00
Iron Cap	Boston Curb	8⅛	8	8⅛	Sept. '20, K	0.25
Isle Royale	Boston	30⅛	29	29⅛	Mar. '23, Q	0.50
Kennecott	New York	41⅛	40⅛	41⅛	Jan. '23, K	0.75
Keweenaw	Boston	1⅛	1⅛	1⅛		
Lake Copper	Boston	4	4	4		
Magma Copper	New York	37	35½	36¼	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2⅛	2⅛	2⅛		
Mass Consolidated	Boston	3¼	3⅛	3⅛	Nov. '17, Q	1.00
Miami Copper	New York	28⅜	28⅛	28⅛	Feb. '23, Q	0.50
Michigan	Boston	2⅜	2⅛	2⅛		
Mohawk	Boston	63	61	63	Mar. '23, Q	1.00
Mother Lode Con.	New York	12⅜	12⅛	12⅛	Mar. '23, K	0.50
Nevada Consol.	New York	16⅛	16	16⅛	Sept. '20, Q	0.25
New Cornelia	Boston	22	21⅛	22	Feb. '23, Q	0.25
North Butte	Boston	10⅛	9[illegible]	[illegible]9⅞	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*84	*78	*80		
Old Dominion	Boston	29	28	28⅛	Dec. '18, Q	1.00
Osceola	Boston	40⅛	39	40⅛	Mar. '23, K	1.00
Phelps Dodge	Open Mar.	†185	†180		Jan. '23, Q	1.00
Quincy	Boston	46	44¼	45⅛	Mar. '20, Q	1.00
Ray Consolidated	New York	15⅜	15	15	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅜	1⅛	1⅜		
St. Mary's Min. Ld.	Boston	48⅛	47	48	Mar. '23, K	3.00
Seneca Copper	Boston	10⅛	10	10		
Shannon	Boston	*99	*80	*81	Nov. '17, Q	0.25
Shattuck Arizona	New York	9¼	9⅛	9⅛	Jan. '20, Q	0.25
South Lake	Boston			*50		
Superior & Boston	Boston	2⅜	1⅞	2		
Tenn. C. & C. cfs.	New York	12⅛	11⅜	11⅜	May '18, I	1.00
Tuolumne	Boston	*45	*40	*40	May '13,	0.10
United Verde Ex.	N. Y. Curb	37⅛	36	36	Nov. '22, Q	0.25
Utah Consol.	Boston	2⅜	2⅜	2⅜	Sept '18,	0.25
Utah Copper	New York	72⅛	70⅛	71⅛	Mar. '23, Q	1.00
Utah Metal & T.	Boston	1⅛	1	1	Dec. '17,	0.30
Victoria	Boston	2	1⅛	1⅜		
Winona	Boston	1⅛	1⅛	1⅛		
Wolverine	Boston	11	10	11		
NICKEL-COPPER						
Internat. Nickel	New York	15⅜	14⅛	14⅞	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	75	75	75	Feb. '23, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	5⅛	5⅛	5⅛		
National Lead	New York	131½	130⅛	131¼	Mar. '23, Q	2.00
National Lead, pfd.	New York	111	110⅜	111	Mar. '23, Q	1.75
St. Joseph Lead	New York	21⅛	20⅛	20⅛	Mar. '23, Q,X	0.50
ZINC						
Am. Z. L. & S.	New York	17⅛	16⅞	17	May '20,	1.00
Am. Z. L. & S. pfd.	New York	55⅛	55	55	Nov. '20, Q	1.50
Butte C. & Z.	New York	10⅛	9⅛	10	Mar. '23,	0.50
Butte & Superior	New York	34⅛	33	33⅛	Dec. '22,	0.50
Callahan Zn-Ld	New York	10⅛	9⅛	10⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	179⅛	177⅛	179	Feb. '23, Q	2.00
United Zinc	N. Y. Curb	1⅛	*99	*99		
Yellow Pine	Los Angeles	*65	*65	*65	Sept. '20, Q	0.03
SILVER						
Alvarado	N. Y. Curb	6⅛	6⅛	6⅛		
Batopilas Mining	New York	½	½	½	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*52	*49¼	*51¼	May '20, K	0.03
Candelaria	N. Y. Curb	*27	*24	*25		
Castle-Trethewey	Toronto	*28¾	*27	*28¾		
Coniagas	Toronto	3.05	3.05	3.05	May '21, Q	0.12½
Crown Reserve	Toronto	*63	*55½	*63	Jan. '17,	0.05
Hilltop-Nev	N. Y. Curb	1⅛	1⅛	1[illegible]		
Kerr Lake	N. Y. Curb	3¼	3⅛	3⅛	Jan. '23, Q	0.12½
La Rose	Toronto	*31	*30	*30	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*25½	*24	*25½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.49	3.45	3.48	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅛	5⅞	6	Jan. '23, Q,X	0.60
Ontario Silver	New York	6	5⅛	6	Jan. '19, Q	0.50
Temiskaming	Toronto	*40½	*37½	*40½	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Carson Hill	Boston	8	8	8		
Cresson Consol. G.	N. Y. Curb	2⅛	2⅛	2⅛	Jan. '23 Q,	0.10
Dome Mines	New York	43	42	42⅛	Jan. '23, Q	0.50
Golden Cycle	Colo. Springs	1.06	1.03	1.06	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	13.60	13.40	13.50	Mar. '23, M	0.05
Homestake Mining	New York	70	70	70	Mar. '23, M	0.50
Kirkland Lake	Toronto	*60	*55	*60		
Lake Shore	Toronto	3.45	3.40	3.42	Nov. '22, Q	0.02
McIntyre- Porcupine	New York	19¼	18⅜	18⅞	Jan. '23, K	0.25
Portland	Colo. Springs	*35	*35	*35	Oct. '20, Q	0.01
Teck Hughes	N. Y. Curb	1⅛	1⅛	1⅛		
Tom Reed	Los Angeles	1.14	1.12	1.12	Dec. '19,	0.02
United Eastern	N. Y. Curb	2⅛	2⅛	2⅛	Jan. '23, Q	0.15
Vipond Cons.	Toronto			*75		
White Caps Mining	N. Y. Curb			*11		
Wright-Hargreaves	Toronto	3.55	3.50	3.55	Jan. '23,	0.02½
Yukon Gold	N. Y. Curb	*95	*90	*90	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*29	*19	*20		
Cons. Virginia	San Francisco	*19½	*12½	*19½		
Continental Mines	N. Y. Curb	5⅛	5⅛	5⅛		
Dolores Esperanza	N. Y. Curb	2	1⅞	1⅞	Jan. '23	2.50
Tonopah Belmont	N. Y. Curb	1⅛	1⅛	1⅛	Jan. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*77	*70	*72		
Tonopah Extension	N. Y. Curb	3⅛	3⅛	3⅛	Jan. '23, Q	0.05
Tonopah Mining	N. Y. Curb	2⅛	2⅛	2⅛	Jan. '23, SA,	0.15
Unity Gold	N. Y. Curb	5⅛	5⅛	5⅛		
West End Consol.	N. Y. Curb			1⅛	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston	17⅛	17	17	Sept. 19, Q	0.25
Caledonia Mng.	N. Y. Curb	*7	*6	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*30⅛	*30⅛	*30⅛	Dec. '20,	0.15
Chief Consol.	Boston Curb	4⅛	4⅛	4⅛	Feb. '23, Q	0.10
Columbus Rexall	Salt Lake	*23	*22	*23	Aug. '22,	0.03
Consol. M. & S.	Montreal	28⅛	28	28⅛	Oct. '20, Q	0.62½
Federal M. & S.	New York			10⅛	Jan. '09,	1.50
Federal M. & S. pfd.	New York	50⅛	50	50	Mar '23, Q	1.75
Florence Silver	Spokane			*38	Apr. '19, Q,X	0.01½
Hecla Mining	N. Y. Curb	9	8⅞	8⅞	Mar. '23,	0.25
Iron Blossom Con.	N. Y. Curb	*34	*33	*33	Apr. '22, Q	0.02½
Marsh Mines	N. Y. Curb	*13	*11	*11	June '21, I	0.02
Park City	Salt Lake	3.30	3.30	3.30	Jan. '23,	0.10
Park Utah	N. Y. Curb			4		
Prince Consol.	Salt Lake	*8⅛	*7⅛	*7⅛	Nov. '17,	0.02½
Silversmith	Spokane			*45	Oct. '22,	0.01
Simon Silver Lead	N. Y. Curb	*34	*32	*33		
Tamarack-Custer	Spokane			1.50	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.97½	2.82½	2.85	Dec. '22, Q,X	0.10
Utah-Apex	Boston	4⅛	4⅛	4⅛	Nov. '20, K	0.25
IRON						
Bethlehem Steel "B"	New York	63½	63½	63½	Jan. '23	0.25
Char. Iron	Detroit	2	2	2		
Char. Iron, pfd.	Detroit	3½	3½	3½		
Colorado Fuel & Iron	New York	29⅛	28	28⅛	May '21	0.75
Col. Fuel & Iron, pfd.	New York			102	Feb. '23 Q	2.00
Gt. North'n Iren Ore	New York	35½	34	34½	Dec. '22	1.00
Inland Steel	N. Y. Curb	50½	50⅛	50⅛	Mar. '23	0.25
Mesabi Iron	N. Y. Curb	11	10½	10⅝		
Replogle Steel	New York	28½	26⅛	27½		
Republic I. & S.	New York	63½	59⅛	61⅛	May '21	1.50
Republic I. S., pfd.	New York	95⅛	95	95⅛	Jan. '22	1.75
Sloss-Sheffield S. & I.	New York	54	52	54	Feb. '21	1.50
U. S. Steel	New York	108⅛	105⅛	107⅛	Mar. '23, Q	1.25
U. S. Steel, pfd.	New York	119	118⅛	118⅛	Feb. '23	1.75
Virginia I. C. & C.	New York	62½	62½	62½	Jan. '22	1.50
Virginia I.C.&C.,pfd.	New York	82	82	82	Jan '23	2.50
VANADIUM						
Vanadium Corp.	New York	42⅛	39⅛	41	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	71⅛	70⅛	71⅛	Oct. '22, Q	1.50
Asbestos Corp. pfd.	Montreal			89½	Oct. '22, Q	1.75
SULPHUR						
Freeport Texas	New York	19⅛	18⅛	18⅜	Nov. '19, Q	1.00
Texas Gulf	New York	61⅞	60½	61⅛	Mar. '23, Q	1.25
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3⅛	3⅛		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	53⅛	52⅛	52⅛	Mar. '23, Q	0.75
Amer. Metal pfd.	New York	116	116	116	Mar. '23, Q	1.75
Amer. Sm. & Ref.	New York	65	63⅛	63⅛	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York			100½	Mar. '23 Q	1.75
U. S. Sm. R. & M.	New York	40	38	38½	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	46	45⅜	46	Jan. '23 Q	0.87½

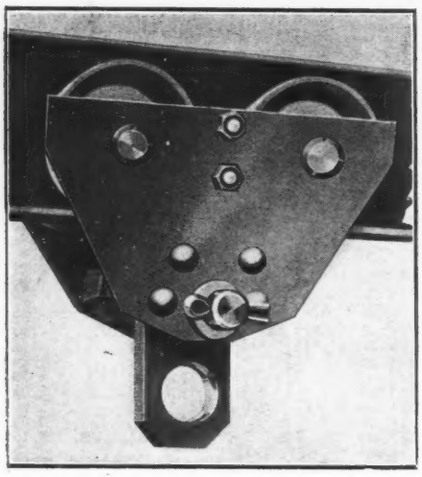
*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

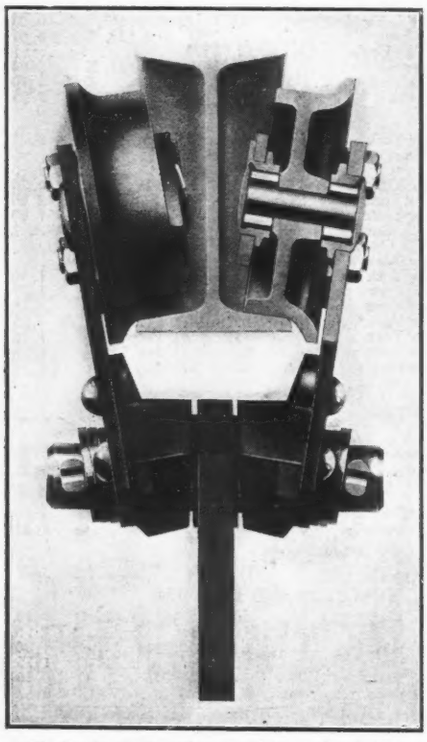
New Steel-Plate Roller-Bearing Trolley

Strength and flexibility, the principal objectives in trolley design, have been attained in a new steel-plate trolley that has just been put on the market. The features of its construction are demonstrated in the accompanying

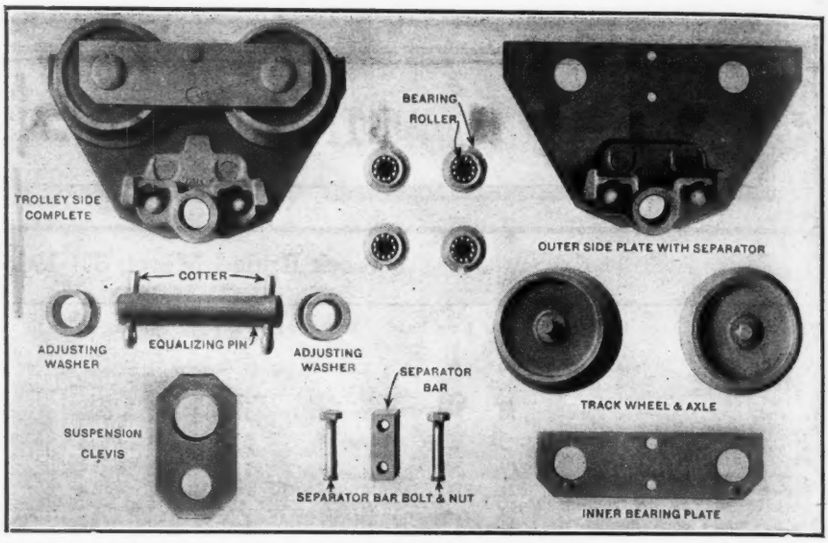


Side view of trolley

illustrations. The wheels are mounted on roller bearings and attached to the side plates, which in turn are connected by the single equalizing pin which supports the shackle plate. Spreader castings riveted to each plate give a large bearing surface for the equalizing pin



End view showing trolley wheel in cross section



Details of steel-plate roller-bearing trolley

and are so shaped as to protect the trolley and act as a bumper which engages the track-stop on the lower flange at the end of the I-beam track. This construction permits a full load to be safely carried on either plate.

The manufacturer of the trolley claims for it a reserve strength of seven times its rated capacity, and a flexibility sufficient to permit a one-ton trolley to run easily on a minimum 21-in. radius curve. The roller bearings are heat-treated, hardened, and ground, assuring easy lateral motion. The grease chamber is designed so as to prevent dust from reaching the bearings. The axles are set parallel to the I-beam flange, pressed into wheel hubs, are supported by the inner bearing plate, and are subjected to practically no bearing strain. The wheels have chilled iron treads conforming to the shape of the I-beam flange. The equalizing pin is of cold-rolled steel, and supports either the shackle, eye, or clevis. Where every inch of head-room is needed, the chain block can be hooked over the pin.

The new trolley is a development of the Yale & Towne Manufacturing Co.

A New Pump Valve

To avoid the rapid and costly wear to which ordinary pump valves are subject, a new valve, known as the "Seal" valve, has been developed by the Worthington Pump & Machinery Corporation, of New York. This valve assures absolute tightness when closed, it is claimed, because flexible rubber is used which will always seat perfectly both at the hub and at the outer rim.

The valve is simple in construction, lacking screws, bolts, rings, nuts, bushings, and rotating elements. A feature is the so-called "bottom plate," which is really a middle seat for the rubber valve proper. When the valve is closed, this middle seat carries the entire load and prevents the rubber seal from cutting on the seats and ribs. This plate moves up and down with the rubber. Thus all mechanical functions requiring strength and wear resistance are cared for by metal parts.

INDUSTRIAL NOTES

The Oilgear Co., of Milwaukee, manufacturer of hydraulic presses, broaching machines, variable-delivery pumps, and variable-speed drives, has appointed the Cleveland Duplex Machinery Co., Inc., 1224 West 6th St., Cleveland, as its representative in the northern Ohio territory.

The Pittsburgh office of the central district of the Cutler-Hammer Manufacturing Co., Milwaukee, will move May 1 from the Farmers' Bank Building to Rooms 950 to 953 Century Building, 7th St. between Penn Ave. and Duquesne Way. A. G. Pierce is manager of the central district and will maintain his headquarters in Pittsburgh.

TRADE CATALOGS

Graphic Instruments—The Esterline-Angus Co., of Indianapolis, Ind., has issued its bulletin No. 223, a four-page leaflet entitled "Some Things Being Done with Graphic Instruments." In it are described various uses for its recording instruments, such as switchboard work, testing pipe, and other mine equipment, checking the operation of air brakes, recording water levels, and recording speed.

Gears—A high ratio gear, in which the feature is a one-tooth pinion made on the helical principle, is described in a pamphlet got out by the Farrel Foundry & Machine Co., of Buffalo, N. Y. In the same pamphlet is described a double helical change-speed gear box for machine tools. An additional folder of the same company is devoted to descriptions of double helical gears, gear units, and to the "Sykes" patent gear generating machine.